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THE
PRACTICAL MECHANIC'S
JOURNAL.

RAILWAY ECONOMICS.—IMPROVEMENTS IN PERMANENT WAY.

In our late remarks upon Mr Adam's Locomotive Carriage for Branch Traffic, we took occasion to remark upon some of the leading points bearing upon the present inordinate amount of deterioration of the permanent way as affected by the introduction of the carriage-engine system. Whilst this system is to be looked upon as one great means of relieving lines of the existing style of construction from the overwhelming expenses of repairs, there is yet another to which we may look forward as promising to be fundamentally effectual in securing lines, hereafter to be formed or re-modelled, from excessive wear, even under the heavy travelling machinery of the present day. It is in the way itself that the proposed advantages are to be secured, and that by a judicious modification of the continuous-bearing system, so long scouted by engineers.

The question assumes a very serious aspect, when it is closely examined; for how can it be expected that lines, originally laid with 50, 60, or 70 lb. rails, for carrying engines of 10 or 14 tons, can be made to withstand the shocks of the modern 25 ton engines? The item of "maintenance of way" has become too formidable to be longer overlooked; in fact, something must be done to reduce its amount, and that at once.

The mere friction of the axles of carriages, or the power necessary to move them on a dead level, does not exceed 4 lbs. per ton; but practically the total resistance is found to range from 8 to 25, or even 30 lbs. per ton. Thus we have a loss of from 4 to 26 lbs. to be laid to the charge of the rubbing between the wheels and the rails, added to the momentum annihilated by the bad joints of the rails, their deflection, and general constructive defects. Again, we have to allow for the great speed at which these overpoweringly heavy engines are now travelling; for when the line once receives an injury, the evil constantly increases, from the leaping of the wheels from one inequality to another.

In all lines with transverse bearings, great loss is occasioned by the unequal strengths of the different portions. Practical test has shown that the deflection of the rail with a given weight is four times as great at the intermediate bearings as at the joints, and hence the jumping motion is vastly aggravated; for no vehicle can possibly pass smoothly over a line whose elasticity is constantly varying. A comparatively weak rail, with well-constructed joints, is far preferable to a heavy rail with badly-adjusted or insecure joints; thus the light rail of the broad guage, with a continuous bearing of timber, is, and must ever be, more mechanically perfect than the chair and transverse sleeper construction of the narrow guage.

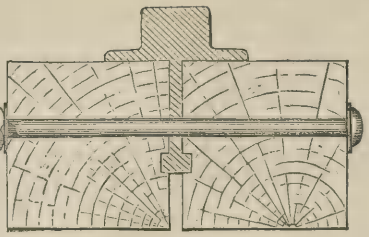
No. 13.—Vol. II.

An insufficient substructure has likewise had a good deal to do with the deterioration of way. The transverse sleepers are frequently too sparingly applied, and too small in size, so that they are liable to sink considerably in the ballast of the way, and the costly operation of "packing" becomes necessary. When we add to this list of objectionable features the decay of timber sleepers, for which no good preventive has yet been adopted, our summary is perhaps complete. In the Eastern Counties line, for example, the capital invested in sleepers alone, is, we believe, very nearly £200,000; and, from a late examination of the line, we are clearly of opinion, that the entire quantity will require renewal within five years, at an expense, calculating each sleeper to cost 5s. when fixed, of some £250,000. That this decay is not overrated, is proved from the fact of entire and radical decay frequently occurring in three years from the time of laying, as in chalk formations, or where the wood is subjected to extreme alternations of wet and dry. Mr. Robert Stephenson was fully alive to the magnitude of the apprehended evils when he stated in the House of Commons, "that if the increased weights and the increased speeds are to be maintained, it will be necessary to relay the lines."

We before remarked, that there are two ways of mitigating or removing the difficulties in question—the adoption of lighter engines, and a relay of the line. Arguing on the broad principle, a large locomotive is more profitable in its action than a small one, provided there is full work in each case; therefore it would appear that the former must answer better, in a commercial point of view, provided its weight and speed are not beyond what Mr. Stephenson has termed the "economic endurance" of the line. Knowing, however, that large engines cannot always be supplied with work to the full extent of their power, the proposition is modified, and light engines may sometimes answer for the traffic, whilst their deteriorating influence on the way is manifestly nothing to compare with that of the former class. As a point of commercial calculation, the speed of an engine may be increased in direct proportion to its lightness, heavy engines being kept exclusively for the conveyance of luggage and other slow trains. The arguments in favour of the light engines have been already fully elucidated in this Journal; we shall, therefore, at once proceed to the consideration of the improvement of the permanent way.

In lines where chairs are used, the latter are required to be long and heavy, to afford a resisting power against the leverage of the rails, which tends to tear them up from the sleeper when side-blows are given from the travelling wheels. No arrangement of the chairs, short of an excessive increase in size, can, however, remove the objectionable wear between the rail and its bed in the chair. To remedy this evil we must do away with chairs altogether. Our accompanying engravings show how this may be accomplished most effectually, at a cost very slightly exceeding that of the present system. Fig. 1 is a transverse section of a single rail with its longitudinal timber-bearing sleeper. Each sleeper is composed of two baulks of timber, 7 inches square, laid together, with a groove cut partly out of each, for the reception of the main central rib of the rail, which is of the cruciform section, the two pieces being secured by transverse bolts passing through them and through the main rib of the rail, which is thus tightly bound between the two timbers. The horizontal web gives the rail the best possible bearing upon the top of the timbers, whilst the binding of the latter upon the central rib, together with the ⊥ edge of the rib, grooved into the timbers, secures the whole most firmly. To prevent the looseness so general in the iron spikes of chairs, the whole bearing surface of the rail would be embedded in tar, so that the timber and metal junction would be hermetically sealed from rust.

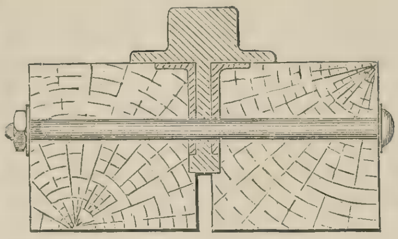
Fig. 1.



1-8th.

Fig. 2, is a transverse section of the same line taken at the joint, showing the fishing-pieces employed as additional securities at the joints. This system of attachment is the invention of Mr. W. B. Adams, by whom it was patented some time ago. They consist of ⅝ inch wrought-iron plates, 10 inches in length, bent over at the top so as to give a surface of 1½ inches resting upon the timber beneath the horizontal seat of the rail. They are of such a depth as to fit in between the ledges of the ⊥ edge of the main rib, and the lower surface of the seat of the rail, a ¾ inch transverse bolt being passed directly through their centre, and through the line of junction of the two ends of the rail. The dimensions of the proposed rail are—breadth of bearing surface for the wheel, 2¾ inches; breadth of cross seat for the timber, 6 inches; thickness of main rib, ⅝ inches; height of rail-surface from surface of sleeper, 2¼ inches; from surface of sleeper to bottom of rib, 4$\frac{6}{10}$ inches.

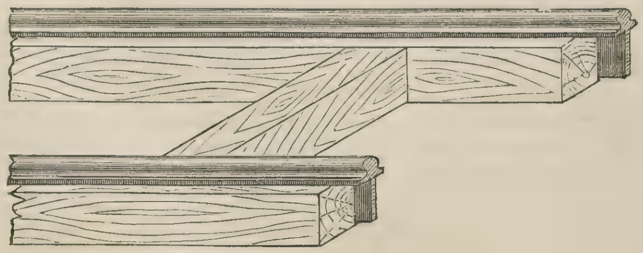
Fig. 2.



1-8th.

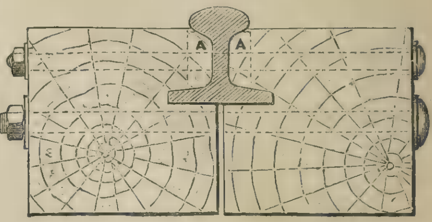
The perspective view, fig. 3, exhibits the general appearance of the line with the transverse timbers, which, with the assistance of a tie-rod, brace the two lines of rails together. These timbers are 7 inches square, and are set at a distance of 15 feet asunder. The joints of the longitudinal timbers alternate with the joints of the rails, so as to equalize the strength of this compound wood and iron rail to the greatest limit. Instead of the fishing pieces, a system of mutual support for the ends of the rails may be contrived by checking a portion of the main rib of one end into its neighbour. For every 15 feet, one cross timber bearer, one wrought-iron tie-rod, and ten connecting bolts are used. Another modification of the longitudinal system is given in figs 4 and 5. Here the rail is of a different section, being like a single **T**, with a bottom-bearing 4½ inches wide. In this case, timbers of 8 inches square are supposed to be employed, set together as before, and having a deep groove cut in each, for the reception of the two edges of the seat of the rail. The whole depth of the rail is only 4 inches; the fishing-pieces, dotted in at A A, are 12 inches in length, and 1 inch thick, as a compensation for want of depth.

Fig. 3.



1-24th.

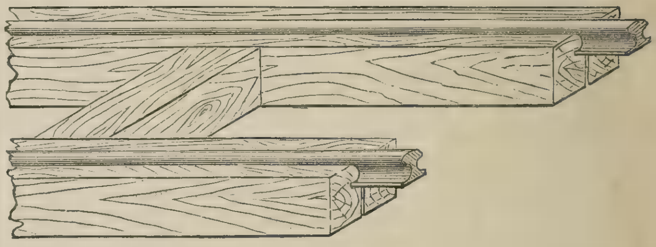
Fig. 4.



1-8th.

Fig. 5 shows a portion of the two lines in perspective. The intermediate connecting bolts of the timbers are put through the centre of the baulks, but at each joint a bolt goes through the junction of the rails. The dotted bolts in fig. 4 explain this. The essential feature of this road is the uniformity of bearing—every inch being equally stiff. When once properly laid and brought to a sound bearing, there is little room for doubt as to the stability of a line thus constructed, and we would venture to affirm that the item "maintenance of way" would soon dwindle down to a mere nominal charge. There are no loose spikes to look after, no shaky chairs, or cracked sleepers, like the one whose portrait is given in fig. 6, unfortunately at present far too common.

Fig 5.



1-24th.

Fig. 6.

As all plans of this kind are primarily reducible to questions of cost, we may present the following comparison between the new plan and that now in process of laying in the south of England—both being supposed to be adapted to similar circumstances as regards position and traffic.

Old System.

For every fifteen lineal feet—

	cwt.	qrs.	lbs.		£	s.	d.
2 15 Feet Rails, (92 lbs.),	8	0	24,	at 6s. 6d.	2	19	1
2 Joint Chairs, (55 "),	0	3	27,	" 4s. 10d.	0	4	5
8 Middle " (30 "),	2	0	16,	" "	0	9	8
5 Sleepers,				5s. 6d.	1	7	6
20 Spikes,					0	2	2
10 Keys,					0	1	0
					£5	3	10

New Plan.

For every fifteen lineal feet—

			£	s.	d.
2 Longitudinal Timbers, 15 ft. (14″ × 7″) = (20′ 5′,), at 2s.			2	0	10
1 Cross Timber, 4 ft. (7″ × 7″) = (1′ 4′,)		at 2s.	0	2	8½
2 Rails (100 lbs. per yd.) 8 cwt. 3 qrs.	20 lbs.	at £10 6s.	2	16	3
4 Flitches, 12″ × 4¾″ × ½″	32 lbs.	at 1d...	0	2	8
1 ¾″ Tie-Rod, 6′ 6″ long	11 lbs. 10 oz.	at 1½d.	0	1	5½
8 ¾″ Bolts, 16½″	29 lbs.	at 1⅝d.	0	3	11
			£5	7	10

Or £1,897. 17s. 4d. per mile.

Few engineers will quarrel with us for asserting that the best line of railway now in existence, is the Great Western. In designing it, Mr. Brunel sought to produce the best possible way, without reference to calculations of cost, and he has succeeded in his object. His plan is, however, open to two objections—the difficulty of keeping the holding-down screws of the rails tight in their places, and the weak section of rail employed. In the plan we have just described, all the advantages of Mr. Brunel's system are gained, without involving its immense cost.

Up to the present time the preservation of the sleepers from untimely decay has hardly received its due meed of consideration; but now, when the subsidence of the constructive mania has commenced, we may hope for attention to this point. Perhaps when railway directors make the discovery that the foundations of their lines are sapped, they will be tempted to expend something upon a preservative preparation.

The timber best suited for lines of this kind is Quebec oak, or American pitch pine, but neither of them will long withstand the effects of their position—half in the earth, and half out of it, without decay.

We have long looked to the longitudinal bearing system as an efficient substitute for that of isolated stone blocks—to which engineers have clung with a most unaccountable tenacity. The stone-bearing surface is almost totally destitute of elasticity—in fact, nothing but a continuous stone-way could be more rigid, more injurious to the carrying stock, or more annoying to passengers. It may be added, that the system we have here advocated has already received a test on a small scale, on a regular working line. The comparison of first cost, with the old plan, which is open for correction, if wrong, shows a merely nominal excess, whilst its chances of remaining in good working order are doubled. So far it has proved successful—the period of its further introduction is probably not far off.

ELECTRICITY AS A MEANS OF PRINTING, COLOURING, AND LUSTRING PORCELAIN AND EARTHENWARE.

By Mr. R. Smith, Blackford.

The existence of this discovery was briefly noted in this journal in October last; and in the present paper it is proposed to redeem the promise then given, of providing further information upon it.

The invention has for its object the ornamentation of porcelain or earthenware surfaces in a variety of media, so as to produce tints of any hue. When the device is to be purple, the ware, when baked, is placed in water for a few seconds, and then in a solution of muriate of tin. The next step, supposing the article to be a cup, is to remove it from the solution, and set it so that the upper surface of its interior shall be in contact with a leaden rod in connection with the cathode or negative end of a voltaic trough in action—a chain being attached at one end to the anode, or positive end of the trough, and at the other to a gold wire. The gold wire is then applied to the outside of the cup, opposite to the leaden electrode, and held as in the action of writing or drawing with a pencil. Whenever the wire comes in contact with the vessel to be operated upon, a purple mark is printed upon it; so that, in this manner, any figure may be drawn upon it, by moving the cup round upon the cathode electrode. In the action, a minute portion of the gold wire is decomposed, and, uniting with a quantity of the tin contained in the solution, forms the purple precipitate of Cassius. After the device is completed, the article upon which it is drawn or constructed is placed in water, and afterwards in the glazing mixture, preparatory to its final completion in the kiln.

By another mode, of greater simplicity, the pattern, as a wreath of flowers for example, is cut out of a piece of gold foil, and mounted upon a band of gutta percha. After immersion in the tin solution, the cup is placed upon the cathode electrode in the manner described in the first process, the chain from the anode electrode being attached to the gold pattern, whilst the gutta percha band is wound round the cup, so as to bring the gold device into close contact with its surface. The cup is then moved round, so that the leaden electrode shall pass over its inner surface opposite to the pattern; and this produces a coloured impression of the pattern upon the porcelain surface, corresponding to the device cut out in the gold foil. The glazing operation then completes the ornamentation. In this detail, a cup only has been mentioned, simply as a matter of convenience in description, for the same process is applicable to vessels of any size or contour. If, for example, it is intended to print or embellish the interior of a saucer, a pattern of foil and gutta percha is constructed to fit the surface to be acted upon, and the cathode electrode is brought in contact with the exterior. To produce various tints of colour in the device, the gutta percha printing apparatus is constructed with various kinds of metals, such as gold, platinum, palladium, silver, copper, iron, or cobalt; and the vessels are wet in nitro-muriatic acid, or in a solution of ferro-cyanide of potassium, instead of the muriate of tin.

Metallic lustres are produced by covering gutta percha moulds, which fit the vessels to be ornamented, with foils of gold, platinum, copper, or iron, the vessels being washed with nitro-muriatic acid, and the adjusted moulds submitted for a short time to the electric current. When the moulds are removed, the vessels are kept moistened with nitro-muriatic acid for a few minutes, to dissolve the oxides deposited upon their surfaces. They are now in a state similar to that produced by a coating of an aqua regia of the metal, and are ready for the glazing process.

By the adoption of the electro-printing system, it is presumed that a great saving will be effected, as it involves the dispensing with the preparation of the salts and oxides, also with printing presses, paper, and varnishes. The particles of the oxides deposited by the electric processes are so minute—so thin and closely placed—that they produce the desired effect almost without perceptibly reducing the bulk of the metals, which will last for an unascertainable period without renewal.

The author's experiments, whence he has deduced the observations made in this paper, were carried on with a common voltaic battery of 32 repetitions of 3-inch plates; but for extensive operations it will require a constant battery of 64 repetitions of 4-inch plates.

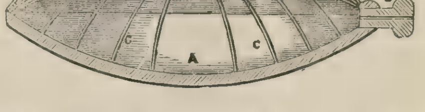
THE ANEROID BAROMETER.

Torricelli's magnificent invention of the mercurial vacuum tube as a measurer of atmospheric variations has lately been threatened with a rival of no mean importance, carrying with it the most overwhelming pretensions to simplicity, accuracy, and portability. The new, or rather the modern-antique, apparatus has received the title of "Aneroid," and has been twice patented in this country, by M. Fontainemoreau, on behalf of the inventor, M. Vidi. The principle of the instrument is dependent upon the action of the atmospheric weight upon the exterior of an exhausted or partially-exhausted case of thin metal, the top of which, being slightly flexible, is so contrived as to convey indications of the minutest changes in the atmospheric column to a graduated dial, upon which the readings are exhibited as in the ordinary wheel-barometer.

In sketching the history of this most ingenious instrument, we are taken back by Mr. Weld,* the secretary of the Royal Society, to the year 1798, when M. Conté† first proposed, and actually carried into effect, a plan, embracing the use of an exhausted chamber as a means of obtaining that portability which the mercurial tube so utterly wants.

The results of M. Vidi's practical researches are given in the *Bulletin des Sciences*, tom. i., from which Mr. Weld has culled the figure which we have here engraved. The instrument bears a resemblance to a watch; it consists of a strong iron or brass box, A, in the vertical section, fig. 1. To the edges of this box, a very thin and flexible steel cap, B, is fitted with great accuracy. C C, are a series of springs, acting between the bottom of the box and its flexible top,

Fig. 1.



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* Athenæum, Dec. 30, 1848.

† M. Conté was the director of the aerostatic establishment at Meudon, and ranked high in his day as an experimental philosopher. His name is yet borne by the French chalk crayons.

so as to press the latter up. A small cylinder is fitted at D, by which the case, when exhausted, may be hermetically closed. The dial is placed immediately over the top of the case, and is pierced in the centre for the passage of a central tube, E, carrying an index-needle, F, the whole being surmounted by a concave glass. It is obvious that, if the space enclosed by the case is exhausted, the flexible top or cap, B, being acted upon by the unbalanced pressure of the atmosphere, will fall, and compress the supporting springs, C; and the converse takes place when any diminution in the atmospheric pressure occurs. By simple mechanism placed in the tube E, this movement of the cap may be communicated to the index-needle, which will thus register the variations in the columnar pressure. It is stated that the thermal changes of the atmosphere disturbed the action of the instrument, and eventually caused M. Conté to discard it as useless.

The objection of the want of any temperature compensation is a vital one, and it is this that M. Vidi has sought to remove in the aneroid of the present day.

In the specification of the patent of April 27, 1844, it is stated that diaphragms of metal, glass, india-rubber, or other flexible air-tight substances may be used as the medium for receiving and indicating the barometrical changes. One of the great features which were introduced at this time was the circular corrugation of the flexible diaphragm—certainly a very happy idea, as it permitted of a great elevation or depression, without danger of rupture; and thus a larger and more available range of movement was obtained. The diaphragm was placed on the top of a circular flat-bottomed box, upon which were set a great number of helical springs, abutting against a number of annular discs on the lower interior surface of the diaphragm, thus diffusing their reactive force regularly over the delicate material.

A peculiar contrivance was resorted to for working the index-needle of the dial. A small cap of metal, projecting inwards from the centre of the diaphragm, carries a nut suspended on a universal double ring joint. This nut works upon a central screw spindle, having very steep threads upon it; and as the diaphragm is elevated or depressed, the vertical movement of the nut acts upon the threads of the spindle, causing it to revolve and carry round the index-needle. This system of connection is at once unmechanical and liable to disarrangement, and in the later barometers it has been remodelled.

Our engraving, fig. 2, is a half-size plan of the instrument as now made under the superintendence of Mr. Dent; fig. 3 is a corresponding side elevation. The vacuum chamber is represented at A; its top and bottom are formed of discs of thin circularly corrugated copper, held together by a circumferential strip of plain metal, as shown in the detail, fig. 4, which is a vertical section of the chamber detached. A strong brass stud, B, is attached to the upper diaphragm of the chamber, having a slot on its end, through which a small projecting pin, C, formed on the lever plate, D, projects, the attachment being effected by a pin passed transversely through the slotted portion of the stud, immediately over the pin, C. The plate, D, which acts as a lever in communicating the movements of the diaphragm, rests upon two pillars, E, carried by the supporting base plate of the vacuum chamber, as fulcra. The projecting lever portion, F, conveys the movement by a joint at G, which is linked to a rocking spindle carrying a lever, H, connected to the arbor of the index-needle by a fine chain, which winds upon it, like the main spring chain of a watch upon the spring-box. In place of putting a set of reacting springs in the interior of the vacuum chamber, a single helix is fixed upon the base plate, so as to abut against the lower surface of the lever at I, and thus preserve the two diaphragms of the chamber from actual contact.

Fig. 2.

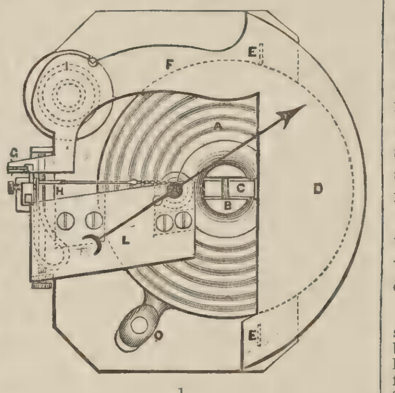

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Fig. 3.

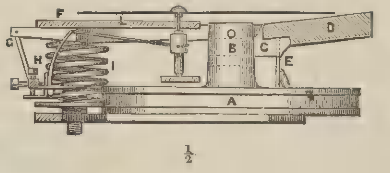

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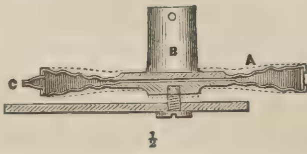
Fig. 4.



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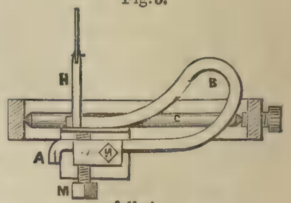
To set the instrument to indicate the same scale as the mercurial barometer, the arrangement, given full size in fig. 5, is adopted to form the connection between the main lever and the index arbor. The link from the end of the main lever is jointed to an eye at A, on a stud formed upon the end of a metal bow-piece, B, the contrary end of which is attached to the lever, H, before described The whole of these parts are carried by a nicely-adjusted rocking spindle, C, working on centres in the frame, L. The office of this contrivance is to afford a means of adjustment for the index movement by the two screws, M, N, one of which elevates or depresses the eye, A, whilst the other sets it in or out from the centre of the rocking spindle, to give more or less leverage, as may be required to suit the barometrical scale. The connection between the index arbor and the lever apparatus being by a flexible chain, its movement can act only in one direction in bringing round the index, and a fine hair-spring is attached to give the return movement.

Fig. 5.



full-size.

The tube by which the exhaustion is effected is at O. The process of exhausting, as specified by the inventor in connection with the original plan, is as follows:—A little solder is placed round the aperture for the exhaust, in which a flat-headed pin is set, so open as to admit the air to pass. The diaphragm is compressed to its proper position by means of a board, and is then soldered to its box. The whole is afterwards placed under an air-pump receiver, having an air-tight stuffing-box, through which a rod, carrying the heated soldering-iron, is passed. When the vacuum is obtained, the soldering-iron is pressed down to melt the solder round the peg, and close the opening.

A simple mode of adjusting the instrument by a standard-barometer is obtained by a screw-stud projecting through the back of the instrument, in connection with the reacting spring at I, the tension of which may thus be varied to the extent required.

Some journeys were lately made by railway from London to Dover with the aneroid, for the purpose of testing the results of the indications of the various levels. In a note given by the Literary Gazette, it is said that a singular disturbance of the index was observed between Folkestone and Dover, when passing through the tunnel, where frequent openings are made to the sea. On passing these openings, the index instantly moved ·025, and then again resumed its original position, showing a momentary change in the atmospheric pressure. Strange to say, on the up journey no such vibration was perceived. Probably the speed of movement has something to do with this, as the up and down rates vary considerably.

In the course of our inquiries as to the accuracy of the instrument, we have been referred by James Glaisher, Esq., of the Royal Observatory, Greenwich, to the following remarks made by him in a letter addressed to Mr. E. M. Clarke:—

> "I have had several simultaneous observations made of the aneroid barometer and a standard mercurial barometer, and to my surprise and great pleasure, every change shown by the latter has as truly been shown by the former, almost in every instance to the hundredth of an inch. During the time of comparison, the barometer reading decreased from 29·5 in. on the 17th instant, to 29·3 in. at midnight on the 18th, and increased to 30·08 in. on the 21st, at which reading it continued for some time, and since then the reading has decreased. Finding the readings to agree so beautifully through this range, and to indicate so small changes of pressure, I have made some experiments with it with respect to different altitudes, and I find that it indicates the change of pressure of 50 feet very decidedly.
>
> "I have also made some experiments upon it with respect to the effect of temperature, and I find that for an increase of temperature of 10°, the readings increase 0·015 in., and this very evenly at all temperatures between 40° and 90°. It would therefore require an increase of temperature of 70°, to cause the readings to increase one-tenth of an inch, owing to temperature.
>
> "Much mechanical ingenuity has been shown by the inventor, and he deserves great credit for this beautiful barometer. It is my opinion that it ought to supersede all ordinary barometers for domestic purposes, as being more accurate and more sensitive than they are, and also that it will be found to be of especial service on board of ships, being free from the objections which are made to the use both of barometers and sympiesometers at sea.
>
> "The effect of temperature is smaller than I expected it to be, considering the length of the levers, and of course it may be entirely neglected for all domestic purposes, but must be taken into account in its use at sea. The temperature correction ought to be determined for every individual instrument."

Mr. Glaisher has also kindly favoured us with the annexed table of his comparisons with a standard barometer. The readings extend over a period comprised between the 12th of November and the 19th of December last, and the greatest error of reading will be found to be no more than 0·018, the standard barometer being then at 30·039:—

1848.	Hour of Reading.	Reading of Barometer Corrected, and Reduced to 32° Fahrenheit.		Error of Reading of Aneroid Barometer.
		Standard.	Aneroid.	
		inch.	inch.	inch.
November 12,	Noon.	30·421	30·418	— 0·003
	9 p.m.	30·457	30·457	0·000
" 13,	Noon.	30·468	30·470	+ 0·002
	3 p.m.	30·441	30·442	+ 0·001
" 15,	3 p.m.	30·477	30·670	— 0·007
" 16,	Noon.	30·325	30·311	— 0·014
	3 p.m.	30·320	30·317	— 0·003
" 19,	Noon.	29·944	29·954	+ 0·010
" 22,	Noon.	29·289	29·300	+ 0·011
	6 p.m.	29·201	29·207	+ 0·006
" 23,	9 a.m.	29·198	29·196	— 0·002
	Noon.	29·212	29·218	+ 0·006
	3 p.m.	29·203	29·209	+ 0·006
	6 p.m.	29·220	29·230	+ 0·010
" 25,	9 a.m.	30·119	30·109	— 0·010
" 26,	Noon.	29·920	29·923	+ 0·003
	6 p.m.	29·898	29·908	+ 0·010
" 27,	9. am.	29·836	29·826	— 0·010
	3 p.m.	29·969	29·960	— 0·009
" 28,	9 a.m.	30·127	30·117	— 0·010
	Noon.	30·079	30·094	+ 0·015
	6 p.m.	30·039	30·021	— 0·018
" 29,	9 a.m.	29·974	29·975	+ 0·001
	3 p.m.	29·924	29·934	+ 0·010
" 30,	9 a.m.	29·931	29·927	— 0·004
December 2,	9 a.m.	29·397	29·400	+ 0·003
" 3,	6 p.m.	29·485	29·489	+ 0·004
" 4,	Noon.	29·158	29·165	+ 0·007
" 6,	Noon.	29·308	29·302	— 0·006
" 7,	9 a.m.	29·544	29·532	— 0·012
" 9,	Noon.	29·211	29·205	— 0·006
" 19,	Noon.	29·890	29·891	+ 0·001

Mr. Glaisher states that his original good opinions of the instrument have been fully borne out in all his later investigations, being "for all ordinary purposes superior to the common barometer, although, of course, not adapted for experimental inquiry."

In the reduction of the readings which we have given, 0·044 has been subtracted for index error, and — 0·0015 + (temp. 32°) for temperature correction, to bring them to the constant temperature of 32°. The correction for temperature was determined experimentally, and the same value was found to apply at all temperatures between 30° and 90°. The coefficient, as found at different times, from experiments separated from each other by a long interval of time, has remained unchanged.

By reference to the column of differences between the reduced readings of the two barometers, they will be found to be small, and to have different signs, and they are all within the error of reading the instrument, the mean of their values being quite insensible. A close examination of the table will show that during the period of observation the variations of reading were great, a great change frequently occurring within a very short time; but the whole of these changes have been almost as clearly given by one instrument as by the other.

At the date of the observations, Mr. Glaisher had not satisfied himself as to whether the zero would change by moving from place to place. In our own opinion, it is to be feared that it would. As in all attempts at the production of a substitute for the cumbrous mercurial instrument, the difficulty here has been the correction necessary for changes of temperature. Originally M. Vidi adopted what he terms a compound bow-piece as a compensator, and the confusion which has arisen from the fact of the doing away with this plan for a more accurate one has involved considerable misunderstanding in the notes of different journalists who have attempted to handle the subject. The wonderful metallic bow-piece, of which so much has been said, is no longer used, and, by an arrangement as simple as it is beautifully correct, the vacuum-case is itself made to afford its own temperature correction, without the addition of a particle of mechanism. Previous to the exhaustion of the vacuum chamber, the top and bottom diaphragms are both perfectly horizontal; but when exhausted, they each take the curve shown in the section fig. 4, and the dotted lines represented as running nearly even with the corrugated surfaces indicate the position they will assume when a portion of gas is introduced to play the important part of a compensator for the disturbance to which the index would be liable from changes of temperature. The expansion of the contained gas, arising from the disturbing cause itself, counteracts the loss of elastic force produced by the same cause in the diaphragms and other parts of the machinery.

We are not told what the gas is, but we know from actual test that it does produce the desired effect to within an inappreciable fraction of mathematical truth, even when subjected to the severest changes of temperature. Calculation gives for atmospheric pressure upon the diaphragm, supposing the interior to be a practically perfect vacuum, about 70 lbs., whereas to elevate it requires only 40 lbs., as shown by a spring balance; the difference is therefore due either to a simply vitiated vacuum, or to the introduction of an additional compensating medium. To understand the action of this compensator, let us consider the main features of the instrument. The external atmosphere is continually endeavouring to press down the diaphragm, whilst the helix beneath the lever is as continually acting to keep it up. An increase in temperature expands the contained gas, which thus diminishes the effect of the external atmospheric pressure, and corrects the disturbance arising from the expansion of the various levers and connections, which would otherwise indicate upon the dial a greater amount of movement than is actually due to the atmospheric change.

We have tested its sensibility in various ways, by conveying it along the steep incline of the Glasgow end of the Caledonian Railway, and by the ascent of several flights of stairs. In each case, where the actual variation of the atmospheric column has been very slight, the index has faithfully recorded the fact; but we have not carried out our test so far as to check its exactitude by comparison with the real state of the case.

The advantages of portability and freedom from derangement are certainly completely secured in the aneroid; and we are persuaded that a few modifications, assisted by work of a more accurate character than that in the instrument before us, will bring the invention into extended use. The connections adopted for conveying the diaphragm movement to the index are crude, ill arranged, and badly made. Indeed, with such mechanism, it can hardly be said that the instrument has a fair chance of competition with the old class of barometers.

BOTANY.

Botany is the science which studies the vegetable productions of our globe, their peculiar structure, their orderly arrangement, and their relation to the other parts of nature. It is susceptible of the following divisions :—1. Botanical Anatomy, or the science of the interior structure of plants. 2. Botanical Organography, or the description of their exterior organs. 3. Botanical Physiology, or the knowledge of the laws regulating vegetable life. 4. Botanical Taxonomy, or the classification of plants. 5. Descriptive Botany, or a description of plants. 6. Geographical Botany, or the laws relating to the distribution of plants on the surface of the globe. 7. Applied Botany, or agricultural, medical, and industrial botany; in other words, an account of the plants useful to man, and of the vegetable substances he derives from them.

Botanical Anatomy.

A cellular tissue, similar to that found in animals, is the fundamental substance of all plants. It is composed of exceedingly minute globules, arranged so as to form transparent vesicles, or bladders, the sides of which touch one another; and, consequently, the membrane separating two neighbouring cells is necessarily double. When the adherence of two contiguous cells is incomplete, the separating spaces are termed intercellular passages. The vesicles of cellular tissue are of various shapes, round, oblong, or in the form of a dodecahedron, a prism, a cylinder, or a spindle. Some plants, such as the fungi and lichens, are entirely composed of cellular tissue; and in the greatest number of plants, there are some parts exclusively formed with it, such as the fruit, the pith, the medullary rays, and all the tissue interposed between the nerves of the leaves. Some of these cells are only filled with air. Very often they contain water, either colourless, or tinged green by a matter named *chlorophyl*, or coloured by different substances. This water frequently holds in solution mucilage, fecula, and various salts. The cells have the power of increase, by splitting into several parts, which in the end become new cells.

The *vessels* of vegetables are modified cells. They may be divided, according to their functions, into two classes—1. *Sap-vessels*, which are truncated cylinders, placed end to end, and having communication with one another. Their surfaces are covered with points or rays, and their office is to convey the sap, or feeding juices, from the root to the leaves. 2. *Air-vessels*. These are formed of a thin substance, composed of fibres wound together in a spiral shape, so as to form cylindrical passages, which only enclose air. They often lose their proper form, and appear as annular and star-shaped vessels. They are found also passing off into the cellular form; for instance, in the trees with acicular (needle-shaped) leaves, where they appear as oblong cells perforated with regular apertures. These spiral vessels are generally found in all the upper parts of plants when young, but rarely in the roots. In trees they usually compose the alburnum and the wood; in palms and grasses they are scattered amongst the cellular tissue. They communicate with the atmosphere by means of elliptical orifices, sometimes termed *stomata*, furnished with a glandulous ring at their mouths. These orifices are found in all the green parts of plants, and particularly on the under surface of leaves. They are wanting in all plants, or parts of plants, which are under water, and they are very rare in thick and succulent plants, such as the house-leek and sedum. Their office seems to be the inhalation and exhalation of air.

By *vegetable fibre* is meant a collection of elongated cellular tissue and vessels. A strong magnifier shows that each fibre is in reality a tube of minute dimensions. Such tubes are not continuous, but terminate here and there in a point. Their embryo may be seen in the mucilaginous juices, where they appear like little bundles of needles crystallizing into form. Such fibre is easily separated in the direction of its length, because in this way we only tear asunder the cellular tissue joining the vessels together; but it is torn with difficulty across, on account of the resistance presented by the vascular partitions, which are tough. This is the substance which is found in abundance in the hemp and flax plants, and which is made to render such important services to man.

The cavities designated as reservoirs of proper juice, because filled with oils and liquid resins, forming the peculiar secretion of the plant, are enlarged intercellular passages. Probably they are the same as the vessels of that kind of sap called latex, described hereafter.

Organography and Physiology.

Those organs which are necessary to the existence and growth of plants are termed organs of nutrition.

The *root* is that part of the plant which is usually concealed under ground, and by which nourishment is drawn into it from the earth. But we must not confound roots with the subterranean stems or rhizomes of the iris, the asparagus, and the ferns. Some plants, such as maire, the aloe, the fig-tree, and the mangrove, send off roots from their stems, which descend vertically into the ground, and serve to sustain the plant against the violence of the wind or water, just as a mast is supported by the shrouds. A root only grows at its extremity, so that if two threads are fixed, by way of experiment, at a given distance from each other upon a root, they will still retain the same distance after the root has doubled its length. Some roots only live a year; at the end of that time they die, and the whole plant of course along with them. These are called annuals. Others live two years, and are called biennial; but there are a great many plants whose life is not limited to a particular number of years, such as trees and shrubs, and these are termed perennial. Climate has considerable influence upon the life of plants. For instance, the reseda and the ricinus, which are perennial in Egypt, become annuals in Europe, where they are killed by the first cold of winter. It is to be observed, that the length of the roots is not always in proportion to the height of the stem. The roots of trefoil are as long as those of the poplar, and longer than those of the fir. Under water this part of a plant receives an extraordinary development. The principal forms of roots are fibrous, as in wheat; bulbous, as in the onion; fleshy, as in the carrot and turnip; ramose, as in trees; fasciculate, as in the dahlia.

Roots fasten the plant to the ground, and absorb moisture from the soil only at their extremity. For this reason young trees drain the earth near them, whilst old ones form a circle, the diameter of which is frequently greater than the height of their branches, and thus the extremities of their roots catch the rain, since they generally extend beyond the space sheltered by the branches. When the branch of a root meets with good soil, it extends itself very rapidly in comparison with those branches which remain in inferior soil; and hence the gardener's saying, 'that roots seek for good earth.'

The *trunk*, or *stem*, is that part of a plant which erects itself into the air, supporting leaves and flowers, and being itself supported by the root. In some plants, however, the stem is wanting; in bulbous-rooted plants the bulb must be taken to represent the stem. Sometimes a stem exists, but it is buried under ground. An instance of this arrangement is found in the sallows which grow on Alpine slopes, where the slipping of the soil covers the stem as fast as it grows, and only branches are visible above the surface. The directions of the stems are various; sometimes they lie on the ground, as in the vine, or creep along it, as in the strawberry plant; or are twining, as in the hop, the bird-weed, the kidney bean. The subdivisions of the stem are termed boughs, branches, and twigs. Sometimes they form an acute angle with the trunk, as in the poplar; sometimes a right angle, as in the cedar, the elm, the oak; sometimes an obtuse angle, as in the ash. The position of the branches usually gives a tree its peculiar appearance by which it may be known at a distance. When growing on a slope, the branches are generally parallel with the ground.

Those plants the stems of which grow from the interior to the exterior are termed *exogenous*, and by far the greatest number of plants belong to this class. When the stem is examined, we find it consists of the following parts: the *medualla* or *pith*, a quantity of cellular tissue placed in a cylinder in young branches (the elder-tree shows it well), which, soft and watery at first, becomes dry and spongy, and then disappears in process of time. The *medullary rays* are thin plates of cellular tissue, analogous to the pith, which join the latter to the exterior part of the plant. These two organs probably serve to feed the young shoots, and hence their disappearance as the plant grows older. Around the medullary rays we may observe a series of concentric and divergent layers of denser matter, which constitute the wood. It consists of longitudinal fibres, and various vessels composed of flattened masses of cellular matter crossing the concentric layers. The cells are arranged in series from the centre outwards, nearly at right angles with the tubes of the concentric layers. Trees deposit a fresh layer of wood every year, and in climates where vegetation is interrupted by winter, we may learn the age of a tree by counting the number of these layers in a section taken near the foot of the trunk. The accuracy of this mode of reckoning their age has been verified in trees whose age was known from other sources. In 1800, De Candolle cut a juniper tree at Fontainebleau, in which he remarked that towards the centre there was a layer of wood which had been frozen, and he counted between it and the bark ninety-one additional layers. By this reckoning he was carried back to the year 1709, and history told him that the winter of that year was one of the most severe ever known. The naturalist, Adanson, found in the Cape de Verd Islands some gigantic Baobab trees of a species to which his name has been given (Adansonia Baobab.) They had upon them some inscriptions and dates which had been cut by Portuguese navigators, and he ascertained that the number of layers separating these dates from the bark was exactly equal to the number of years elapsed since the date of their voyage.

Such layers are not always developed equally on all sides; hence the origin of eccentric trees. It may happen that on one side no layer is developed, whilst on the opposite side a remarkable increase is noticeable. In general, the thickness of the annual deposits goes on decreasing regularly from the middle to the outside, but there are numerous exceptions to this rule. The ligneous layers have not an equal strength; those in the middle are the strongest, and form the perfect wood, or the heart of the tree, which is frequently distinguishable by colour from the wood outside. In the ebony it is black, yellow in the cytisus, brown in the oak and elm. Next the outer wood, which is generally of a softer texture and of a light colour, hence termed alburnum, comes the bark, which, when fully developed, is composed of four parts:—1. A dry, tough membrane, the epidermis; 2. The cellular integument, a layer adhering to the cuticle; 3. A vascular layer; and 4. The inner bark, a layer of fibrous texture, of a whitish colour, which botanists call liber. A fresh layer of liber is deposited every year within that of the preceding year, that is, between the old liber and the alburnum. Thus these two portions of a tree grow in different directions, for the alburnum increases from the interior, and the liber in the reverse way. If a foreign substance is inserted in the former, it becomes covered in time with wood; if in the latter, it travels towards the outside. In some trees, such as the cork tree (*quercus suber*), the outer bark is of great thickness. On the young branches of elms growing in damp shady places, an accidental development of the same substance takes place, and in some trees, as the plane, it breaks into flakes, as the tree grows, and falls off.

With the view of seeing how a stem increases, let us take a young oak at the time of its germination. The root is buried in the soil, and a small stem shoots upwards, bearing a bud at its summit. Winter comes, and the process of growth is stopped, but in the following spring the bud sends out another shoot in continuation of the former. The third year another shoot is made in like manner, and the increase in height is accompanied by an increase in bulk. In fact, a fresh layer of alburnum and another of liber is formed every year, and these layers are in the shape of cones nested within one another, and extending from the base to the summit of the plant. A vertical section will show this. In time, the oldest layers of alburnum, which is a substance with almost as much irritability as the liber, are converted into perfect wood. We may consider the branches as so many new plants growing from a common trunk, upon which they show themselves at first as buds.

Of *endogenous* plants, such as palms, we have no specimens in our climates; these are confined to the intertropical regions. Their structure is quite different from that of the exogenous plants. No medulla or medullary rays are found at the centre of the trunk, but only distinct ligneous fibres, separated or united simply by a loose cellular tissue. As we approach the circumference, these fibres are drawn closer together, and at length form perfect wood, which surrounds the central part like a hollow cylinder, and thus the hardest part is outside. The woodman who fells an oak meets with more resistance the deeper he goes; but the savage who attacks a cocoa-nut tree finds that his axe penetrates more easily after it has got through the exterior portion. Endogenous trunks have no true bark. The outer coat is formed by the base of leaves which have fallen off. A palm tree increases at first both in height and diameter; but when it has attained certain dimensions, when the exterior fibres have formed an inexpansible ring of wood, then its increase in thickness is stopped, and the tree, instead of exhibiting the conical shape of our oaks and elms, is cylindrical throughout.

There are various modes by which plants propagate. If we bend down a young branch from a tree into the ground, it will soon throw off roots, and we may then separate it from the parent tree, and by this means produce a new individual. This is called propagation by layers, a mode which is usually taken with the more delicate or valuable plants, such as are found in greenhouses. Other trees, such as the willow and the poplar, which readily throw off roots, may be propagated by cutting a young shoot, or tearing off a branch at the joint, and placing it in the ground. This is called planting by slips or cuttings. Grafting consists in the junction of two branches of the same individual, or the fixing of a young shoot upon an older stock of a similar species of tree. This is a good deal practised with a view to the improvement of fruits.

Appendant organs is the name given to all the organs which are supported by the trunk or stem. They may be divided into organs of nutrition and organs of reproduction or fecundation.

Amongst the former class, we may notice certain filiform appendages, analogous to the hair of animals, and bearing the same name on plants. Some are simply elongated cells; others are composed of several small cells placed end to end; others are ramose, star-shaped, &c. Some have a gland at their base, like the common nettle; and when the hair, which is hollow and shaped like a minute thorn, pierces the skin, the gland being compressed, a stinging liquid runs through it, and is deposited in the wound. It is supposed that these hairs protect some of the organs against cold, and that they prevent a too rapid evaporation. It is observable that plants which are not furnished with stomata are generally unprovided with hairs.

Buds are ovoid bodies of various appearances, which push themselves forth in the angle where the leaves spring from the stem. Some of them only contain leaves (folliferous), others only flowers (floriforous), others contain both. Their sheaths are formed of leaves, or abortive stipules. Some buds are smeared with a kind of resinous matter, which prevents the rain penetrating into the inside and injuring the delicate parts.

Leaves are expansions of a bundle of fibres, exceedingly varied in shape, but usually coloured green. When these fibres begin to spread out into a leaf, as soon as it leaves the stem the leaf is said to be sessile; but in the majority of cases the leaf is fastened to the stem by a short stalk, called a petiole or foot-stalk. When the lobes of a sessile leaf embrace the stem, it is termed amplexicaule. Sometimes the petiole itself composes a leaf, of which, by dilating, it takes the form; it is then termed phyllode. An expansion of the petiole, composed of a layer of cells closely packed together, pierced by elliptical or rounded holes (stomata or mouths), which communicate with the intercellular passages of the leaf, forms the coat or epidermis of the two surfaces of the leaf. Ramifications of the petiole, called nerves, becoming more minute as they are subdivided, form the skeleton or framework of the leaf, the interstices of which are filled with a soft pulpy matter. The nerves are vascular, the filling-up, cellular tissue, and the intercellular passages of the latter are very large, especially on the under side of the leaf, where the epidermis is pierced by a greater number of orifices, and is more thickly set with hairs. The inferior surface of the leaf is invariably turned towards the ground. In the weeping ash, the branches of which are bent downwards to the earth, all the foot-stalks of the leaves are twisted, so that the normal position of the leaves is restored.

With respect to form, leaves are either simple or compound. Simple leaves are composed of a foot-stalk and the proper leaf; their figure depends on the manner in which the nerves ramify. If the nerves remain parallel, although further apart than in the footstalk, ribbon and sword-shaped leaves, like those of the iris and the cereal plants, result. In other cases, the nerves radiate from the point where the footstalk and leaf join as from a centre, as, for instance, in the monkshood. In the maple, we see the nerves separating like the fingers of the hand. In the elm and poppy, we see the footstalk prolonged through the leaf, like a great central nerve, and dividing it into two symmetrical parts, the nerves branching off laterally like the feathers of a quill. When the edge of a leaf is cut into tooth-like projections, it is said to be *dentate;* when the cutting is irregular, *lacinate;* and when deeply separated into distinct divisions, *lobed;* when more than half way divided into several finger-shaped lobes, the arrangement is called *palmate;* when the divisions extend almost to the midrib, *pinnatifid.* Other shapes are named from the objects which they most resemble, such as ensiform (sword-shaped), sagittati (arrow-shaped), uncinate (hook-shaped), &c. For an explanation of such terms, and for a full list of them, works on Botany, like Professor Lindley's Treatises, or Macgillivray's edition of Withering's Botany, should be consulted.*

When several leaves are placed upon one petiole, they are termed compound. Sometimes a leaf is apparently simple, when in reality it is compound. This happens when only one of the leaves is developed, like those of the orange tree. When the leaflets grow in the same plane on a common footstalk, they are said to be *pinnate,* or winged; of this form the acacias furnish beautiful examples.

Some leaves possess, to some extent, the power of motion, a power which links them to the animal kingdom. Many of the pinnate-leaved plants present the phenomenon of sleep, as it is called; that is to say, that in an evening the leaflets fold themselves up for the night, and continue thus until daylight, when they resume their former position. De Candolle made some plants of this kind reverse their habits, by throwing upon them a strong light through the night and placing them in darkness through the day. This showed that their movement was due to the action of light. If we gently touch the leaves of the sensitive plant, the leaflets are seen to shrink, and a rougher touch makes them fold up. Similar effects are produced by the wind, heat, cold, electricity, and even the shadow of a cloud. When the action ceases, the leaves resume their usual posture. But habit and repetition blunt this sensibility, and when a plant is placed in a carriage, though the first shocks affect the leaves, they become in time used to the motion, and open themselves out as if perfectly still. Other plants of the same species have a similar power of motion, but in a less degree. The Hedysarum gyrans, a plant growing in Bengal, has leaves composed of three leaflets. The two lateral ones rise and fall alternately by little jerks, which vary in rapidity. The reason of this phenomenon has not been ascertained. When the sky is covered with clouds, the leaves of the Porliera hygrometrica lie close upon the stem. Those of the Dionæa muscipula, a North American plant, which inhabits marshy places, are terminated by two lobes, united by a sort of hinge in the middle, and set with glandulous hairs. When a fly alights upon these hairs, the lobes curl up and secure the insect. There is also a plant in our own marshes, the sundew (Drosera rotundifolia), which has small leaves covered with hairs, and with a viscid secretion in globules. Insects, attracted by the liquid, settle upon the leaves, and immediately the hairs rise up, interlace, and they are caught as in a net.

At the base of the footstalks of some plants there are scales or small leaves, called *stipules.* In the pea they are as large as the leaves themselves; in the Lathynus aphaca, they persist when the leaves fall. Sometimes, as in the rose, they are joined to the leaves; those of the Ficus elastica envelope the bud, and fall off when it is expanded; and in some of the acacias they change into spines.

Tendrils are organs found upon some plants, the office of which is to lay hold of other things by way of support for their own weaker structure, and they are usually in the shape of a spiral, because they are then capable of expansion and semi-elastic. In the pea and the cobea, the tendrils are the extremities of the leaves; in the pink, the leaves themselves; in the smilax and the bryony, the stipules. In the nepenthes distillatoria, the tendril is terminated by a cup, in which the plant secretes a pure liquid, capable of quenching the traveller's thirst.

The *nutrition* of vegetables, like that of animals, consists of two processes; the introduction into the plant of alimentary substances, or the absorption and circulation of nutritive juices; and their modification, under the influence of atmospheric air, or respiration and absorption. Plants live only on liquids, and the earth may be regarded as their common stomach. These liquids are taken up by the ends of the roots, or by the fine hairs with which roots are generally covered, the points being furnished with a spongy cap to facilitate absorption. These vessels have the same office as the lymphatic vessels in animals. The greatest quantity of liquid is taken up by the extremity of the root. A carrot will increase much more if the end of the root touch water than if all but the end be immersed. There are some plants, such as the misletoe, which live parasitically upon others, the nourishment of which they absorb.

Along with water, plants also suck up various salts. Saussure found carbonate of lime in some rhododendrons which had lived in calcareous earth, and some silex in some which had grown upon granite. The smooth coating of common straw and that of the stalks of other cereal plants contain a considerable quantity of silex; and in the joints of some articulated plants, grains of the same earth have been found. Plants which grow by the sea contain marine salt, and those which sprout among rubbish, nitrate of potash. Certain salts, such as those of strontian, are not taken up; nor are some liquids which are very feeding when diluted, such as a strong solution of gum or manure. Corrosive liquids, such as acids, and a solution of sulphate of copper, destroy the extremity of the root, and thus penetrate easily.

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* We may refer the reader also to an extremely useful little chart, embracing the terminology of the science, and an outline of the Linnæan system, drawn up by Mr. Rattray of Glasgow, and published by Messrs. Blackie.

When the liquid has entered the root, it takes the name of *sap;* and, ascending through the appropriate vessels, like blood through the veins of the body, it conveys nourishment to the various parts which are capable of assimilating it. The cause of this movement of the sap is not exactly known, but it is usually considered to be the irritability of the vessels. Cold checks it, and so does a succession of electric shocks; heat, dryness, the stirring of the surrounding air, and the number and size of the leaves influence it; evaporation under these circumstances, being more rapid, the absorption becomes more active. If a branch of vine be introduced into a hot-house in midwinter, the root remaining in the open air, sap will ascend, and it will put out leaves and sometimes flowers. Sap flows with great rapidity. The root of a pear tree was placed in a tube full of water, the bottom of which was plunged into a mercury bath. In six minutes the mercury rose more than eight inches in the tube, to replace the water abstracted by the tree. Where a similar experiment was tried with a branch, the mercury rose five inches in half an hour. The quantity of sap varies not only with the size but the species of trees. It is most abundant in the soft-wooded trees. If the sap meets with no interruption, it reaches the leaves, where it is placed in contact with the atmosphere, which modifies it, as will be shown under the head of Respiration.

When so modified, it descends along the branches and trunk; when uncoloured, it is called cambium; when coloured, latex. It travels between the wood and the inner bark, and determines the formation of a new layer of alburnum and of a new layer of liber. In the poppies and the euphorbias, the descending sap is white; in the celandine, yellow; in the purslane, green; in the sanguinaria, red, &c. In the siphonia elastica, it contains caoutchouc; in the bread-fruit tree, albumen, sugar, and wax; in the poppy, opium; and in several trees, gum resin. The microscope enables us to perceive the fluid circulating in the intercellular passages of some plants.

In addition to this general circulation of juices, another partial one has been discovered, which has received the name of gyration. It was first noticed in the chara flexilis, an aquatic plant composed of a number of hollow-jointed cylinders, separated from each other by partitions. One of these cylinders being placed under the microscope, a liquid, holding in suspension green particles, is seen to move up and down in parallel lines, between two partitions. If a ligature be placed round the middle of the cylinder, it has the effect of a new partition, and the gyration becomes divided into two. This singular property has since been observed in a few other plants. The action of strong acids, of a powerful electrical shock, of an exhausted receiver, stop the motion entirely. Opium, weak acids, and alkalies make it cease for a time, but when their action is over, it recommences with unabated energy.

MANUFACTURE OF SULPHURIC ACID.

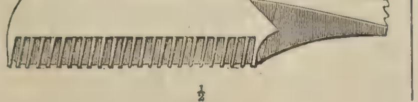
At a late meeting of the Manchester Chemical Society, Mr. F. C. Calvert delivered a lecture on the history and manufacture of sulphuric acid, in which he elucidated many interesting and little-known facts. The following abstract of his paper, for which we are indebted to the *Manchester Courier*, is worth the attention of the young chemist:—

Sulphuric acid is one of the most important products connected with chemistry; indeed it is the basis and fulcrum of all mineral chemistry. Chemists by it generate most of the other acids, and without it many arts and modes of industry would be unknown. In the present day the industry of nations in represented by two powers—the mechanical, represented by the iron they manufacture or consume; and the chemical, represented by the sulphuric acid they consume. The acid is not found in large quantities free in nature, though in the Rio Venaigra, in the Cordilleras, a considerable amount of it could be found in that state; but it is abundant, combined with lime, iron, copper, zinc, baryta, strontia, and other minerals. It was first mentioned in scientific books in the 9th century, but the man who first gave us the idea of its preparation was Basie Valentin, who wrote in the 15th century, calling it oil of vitriol, a name it still maintains, because green copperas, from which it was then prepared, used to be called green vitriol. Subsequently it was found that a solution of sulphurous acid exposed to the air became rapidly oxydised, and produced sulphuric acid, and from this it was seen that oxygen was the agent required to change sulphurous into sulphuric acid. Nitre was therefore added, and the effect was produced. The idea of employing the leaden chambers now in use was first acted upon in Birmingham, by two men named Garbette and Roebuck, and the employment of those chambers, and the oxidation of sulphurous acid by means of nitre, which was adopted by a chemist named Ward, have been the two causes of sulphuric acid being manufactured with so much facility and at so cheap a rate. There are in reality three sulphuric acids —the anhydrous, which contains no water; the Nord-Hausen (so called from the place of its preparation in Saxony), a brown liquid; and the commercial. These are distinct; and there are also four distinct hydrates, one containing one part of the acid to one of water (the commercial), another, two of acid to one of water, a third, one of acid to two of water, and a fourth, one of acid to three of water. The anhydrous does not exist in nature free, but it is found combined with some few bodies, such as lime, baryta, strontia, and lead. It presents itself in needle-shaped crystals, which melt into liquid at a temperature of 77°; when exposed to the air it gives off white fumes, and it has such an affinity for water that when put in contact with it, a hissing sound is heard, as if a redhot poker was introduced. It is generally prepared from Nord-Hausen by distilling it and condensing it in a tube surrounded by ice. But another method of procuring it was discovered in the year 1842 or 1843, by a gentleman named Larock, an assistant to a lecturer in Paris, and it has been patented in England by another Frenchman, named Prelier. The discovery of this solid form of sulphuric acid was most important, because in our colonies, by the want of it, capitalists were stopped from prosecuting many arts for which they had otherwise ample means; its dangerous character in a liquid state has caused captains of ships peremptorily to refuse to carry it; so that an article which is to be had in England at 1d. or 2d. a lb. cost in the colonies from 4s. to 5s. per lb. In the solid form, however, it can be conveniently packed so as to be guarded against the occurrence of almost any danger. Its value in our own manufactories is the facility with which it dissolves indigo; it effects that much quicker than the commercial. Larock's method of preparing it consists in taking anhydrous sulphate of soda, and mixing it with sulphurous acid. This forms a double sulphate of soda, which is decomposed by applying heat, part of the water is driven away, and by applying more heat the anhydrous acid comes off in fumes, which condense in beautiful crystals on the sides of the receiver, and leave in the retort the neutral sulphate of soda. The Nord-Hausen is prepared in Saxony, at the place after which it is named, where there are extensive mines of green copperas—a salt composed of one part of sulphuric acid, one of oxyde of iron, and seven of water. By applying heat to the copperas they get a residue, which is composed of sulphate of iron with one part of water, for by drying it slowly, six equivalents of the water are driven off, and the residue is an anhydrous powder, (except the one part of water,) from which the sulphuric acid is obtained by dry distillation. The Nord-Hausen is anhydrous and sulphuric mixed with sulphuric acid, and it is employed chiefly in the arts to dissolve indigo, principally on account of its concentration, the solubility of indigo being in a ratio to the concentration of the agent employed. Indigo requires five or six times its weight of the commercial sulphuric acid to dissolve it, of the Nord-Hausen three or four times its weight are sufficient, and of the solid or anhydrous from one to two. Nord-Hausen is now prepared in very extensive furnaces in England. The commercial is composed of proportions equal to sulphur 1, oxygen 3, chemical preparation of water 1. It is produced from sulphurous acid, which only required more oxygen to become sulphuric: the difficulty, however, is to make it take the one equivalent of oxygen. Within the last few years a method has been adopted of using catalitic bodies, which, while undergoing no modification themselves, force the oxygen to combine with the sulphurous acid. One of these is platinum moss, the other pumice stone. The method of employing platinum moss was discovered about ten years ago by Kuhlman; the moss has the power of condensing the gases, it absorbs the sulphurous acid and the oxygen; but this plan is far too expensive to be available for general purposes. Last year a patent was taken out to produce it by the same process, only employing pumice stone, which has the same properties as the moss, though with the additional and objectionable feature, that after a certain time it loses its condensing power, and must be replaced. The experiments with it, however, have not yet been sufficiently numerous to state certainly whether it will be successful or not. If, however, we have arrived thus far in our knowledge, we are nearer the hour when simple and cheap means will be quite available. The preparation of commercial oil of vitriol may be treated of under three heads, the production of the requisite substance, their mutual action in the process, and the concentration of the manufactured article. The three bodies which must be generated, are sulphurous acid from sulphur, hyponitric acid from nitric acid, under different forms, and steam from water, and these bodies react on one another in such a manner as to generate the sulphuric acid. It is nothing more than the passing over of the oxygen from the hyponitric acid to the sulphurous acid to make sulphuric acid; and if we could add oxygen to the nitrous acid the action would continue to go on, but as air is employed, in every 100 parts of which there are 79 of nitrogen, a strong current is necessary to get rid of the latter gas, and a considerable loss of the oxydising agent or nitrous fumes is the consequence. Sulphurous acid is generally produced by burning sulphur; but within the last few years, and principally in 1841, when a dispute existed between the English government and the King of Sicily, the manufacturers tried to find another system, and to produce it by roasting pyrites, a double sulphuret of iron, (two parts of sulphur to one of iron.) By exposing that body to the action of heat a part of the sulphur is transformed into sulphurous acid; but this means was the cause of most serious evils, for much of the pyrites contains arsenic, and therefore the oil of vitriol has it also, and the universal use of the acid introduced the arsenic into almost every thing, even into the powders which are now so commonly used as "baking powders." The hyponitric acid, within the last few years, has been produced from nitre and soda mixed, so as to form a nitrate of soda, which having sulphuric acid added to it, the nitric acid is obtained. There are several modes of obtaining the sulphuric acid from these generators; the one most commonly in use is capable of producing from $7\frac{1}{2}$ to 10 tons. per day. The process is conducted in leaden chambers, measuring respectively about 6490, 135,200, 62,40, 15,523, 14,784, and 170,000 cubic feet. Notwithstanding the immense capacity of these chambers, in which 31,000 feet of air circulate, a large amount of nitrous fumes is lost. To avoid this, two means have been put in practice; one consists in having large cylinders 38 feet high, through which a stream of oil of vitriol constantly falls, and, dissolving the nitrous fumes, enables the manufacturer to employ them again, and thus effect a saving of from 3 to 4 per cent. of nitre compared with the amount of sulphur employed. When it first escapes, the acid has a specific gravity of 1.55 to 1.60, and it is put into pans, and about 11 per cent. evaporates; that brings it up to the specific gravity of 1.70, and beyond that, the process cannot go in the concentrating pans, or the product will attack them. But a specific gravity of 1.84 is necessary, and this is got by evaporation, often in glass retorts, but also in stills of platinum—a metal that the acid does not act upon. These stills are exceedingly expensive, costing from £1000 to £2000 each. As the liquid in a heated state is a most dangerous article, the syphon is used to fill the stills, and to decant it when sufficiently concentrated, and thus danger to life and limb is obviated. By the ancient method, 100 lbs. of sulphur, with from 6 to 10 lbs. of nitre, used to give about 150 lbs. of the acid; at the present day, and principally through the use of the condensers, from 100 lbs. of sulphur, with about three or four parts of nitre, we can obtain from 300 to 306 or even 310 lbs. The specific quantity of the commercial acid is 1.845, or 85 parts of acid to 15 of water, or 169 Twaddle. Its action on the organic matter is to give colour, forcing the hydrogen and oxygen to combine and form water, and the carbon liberated, gives it a brown colour. This acid is not useless, as is often believed, for a limited ebullition will restore its properties. It absorbs 15 times its own bulk of water, and then it loses its commercial value. When that is the case it may be boiled in glass vessels, and water will evaporate, but that is a dangerous process. Manufacturers who are careless as to how they leave their acid, are often deceived as to its deterioration, and, finding its action insufficient, cast the blame on other quarters, which belongs to themselves for want of proper attention. It does not become solid when it is concentrated, except at several degrees below Zero, but the diluted does so at the freezing point.

The various processes were illustrated by a series of coloured drawings, beautifully executed by Mr. F. Wise, of Cooper Street.

THE PLANTAGENET GUARD RAZOR.

This royal name derives its origin from a simple application to the ordinary razor, whereby perfect security from accidental cuts of the skin is secured. Most people occasionally wound themselves, when in a hurry, or by trusting to a bad razor; and the seeming difficulty of preventing such casualties made us rather sceptical as to the efficiency of any purely mechanical contrivance for the purpose, until actual test removed all doubt. Our engraving shows a half-size elevation of a razor fitted with the slotted guard which constitutes the improvement. A small stud-screw is tapped into the centre of the back of the razor, so as to be easily adjustable by the fingers. The guard is of Britannia metal, or German silver. It is nothing more than a thin sheet, slotted on one edge like a coarse comb, and bent at a right angle on the other, to fit the thick back of the razor. The angular portion has a short narrow slot of the width of the stud-screw, terminated at one end by a circular opening, just wide enough to let the head of the stud pass through, so that the guard can be easily attached to or removed from the razor, by sliding it a short distance up or down.



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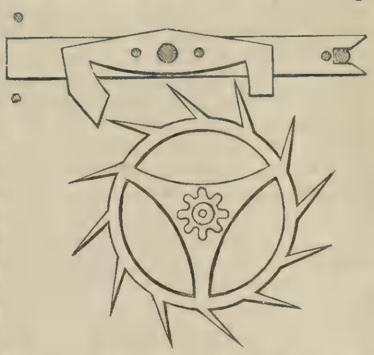
When properly fitted on, the plane of the teeth of the guard coincides with the cutting edge of the razor, the teeth projecting a little over the edge. Thus, in the act of cutting, the teeth come in direct contact with the skin, and the cutting edge only just touches it, and cannot take up enough to injure it, as the teeth hold it down.

With a good razor thus fitted, the cutting action is not felt; the only sensation being that of a comb passed over the surface. The contrivance certainly lays claim to a considerable amount of ingenuity.

YATES' DEAD-BEAT, HALF-SECONDS' WATCH ESCAPEMENT.

This escapement is the invention of Mr. Thomas Yates of Preston, Lancashire, who obtained a patent for it in 1846. The inventor's idea has been a reduction in the number of vibrations of the balance-wheel in a given time, and the securing of a more correct dead-beat, than is found in ordinary watches. Half-seconds' escapements are by no means of modern date, but from the fact of their non-existence in watches of the present day, we are led to presume that the originators of them have not carried out the system so successfully as Mr. Yates.

In our engraving, we have given a plan of the escape wheel, lever, and pallets, on a scale four times larger than that of an ordinary watch. The escape wheel has 12 teeth, slightly undercut, but not nearly so much as in the usual detached lever escapement of 15 teeth. When a tooth of the escape wheel falls, to rest upon the circular portion of the pallets, all the wheels are locked, whilst the balance vibrates half a circle, free and independent of the wheel-work. When the balance returns, the ruby pin, coming into contact with the notch in the end of the pallet lever on the right, unlocks the escape wheel. The tooth now gets on the incline, or impulse part of the pallets, which causes the lever to strike the ruby pin in the notch, and gives a vibration to the balance wheel, in the opposite direction. In the return movement, the coiled balance spring re-acts, to bring back the balance, and thus unlock the wheels, to give it a fresh impulse.



The pallets and lever are on the same axis, and are pinned together. A little above the lever, a roller, slightly flattened on one side, is placed, and near the edge of this flat part the ruby pin shown in the end notch of the pallet lever is inserted. At the opposite end of the lever, and on each side, are two stops, termed "banking pins." When the balance vibrates to the left hand, it moves the lever out of a right line resting against one of these pins, leaving it in the best position for the reception of the ruby pin, in the return vibration. When this takes place, the lever is moved in the opposite direction, until it is brought up by the opposite banking pin. At the end of the lever, and as close as possible to the bottom of the notch, is set a small pin, which obtains the name of the moving banking pin. When the balance is at rest, the flat side of the roller is just opposite this pin, and if the roller had no flat side, it would touch the small pin, and stop the vibration of the balance; but so soon as the ruby pin has moved itself out of the notch, one of the two banking pins comes into action, and, as the lever is moved out of a right line, the moving banking pin, on the end of the lever, is free of the circular portion of the roller, so that any violent motion cannot derange the escapement's action.

The lever is always kept from flying out by the two fixed banking pins—and, at the same time, it is prevented from falling in, by the moving banking pin at the bottom of its notch. With a balance of a proper size and weight, and a duly-adjusted balance spring, any ordinary usage will not affect its time-keeping; for if the vibrations are extended through some violent shock, the balance spring will have such command over the balance, that the long vibrations will be performed in the same time as the short ones.

The chief advantages which Mr. Yates has attempted to secure in his new movement are—the power of carrying a balance wheel, much heavier than that of common escapements, and requiring less power to impart motion to it; the reduction of the speed of working, by arranging the wheel-work train, so that each vibration measures a half-second instead of a quarter-second; a greater facility of unlocking the escape wheel teeth, by reason of their slight amount of under-cut, and their distance apart; the obtainment of a more powerful pallet lever, by the adoption of pallets of a new form.

It is presumed, and with justice, that the heavy balance, when driven with freedom, will prevent any sensible derangement from defects in the rest of the machinery, as its momentum will carry it over slight irregularities, whilst the greater strength of the balance, or hair spring, adds a practical advantage of some value, for it tends to equalise the long and short vibrations. Whether the whole of these advantages are really gained by this system requires more consideration than we can at present bestow on the subject. We know, however, that Mr. Yates' watches do perform very correctly, and, as an expression of the value of the invention in the eyes of the Society of Arts, he was rewarded for it by their large silver medal, in May 1848.

OUTLINE OF ASTRONOMY.

No. V.—MARS.

The planet Mars is distant from the sun about 159 millions of miles. Its volume is only about six times that of the moon, or three times that of Mercury. The diameter of the sun appears of a less size from Mars than it does from the earth; in fact, it is only four-ninths of the size it appears to us, and light and heat bear the same proportion. Its speed in performing its revolution round the sun is estimated at 58,920 miles per hour. Its lustre is dull and reddish, and it is conjectured to be surrounded by a thick and cloudy atmosphere. The mean duration of its sidereal revolution is 687 days; that of its synodic revolution is about 780 days. Its movements are apparently uneven like that of the other planets, because we are not placed in the centre of the system. When we see him in a morning issuing from amongst the rays of the sun, his motion is direct and most rapid. He gradually lessens his speed, and seems to come to a spot at a distance of 152° from the sun. He then begins a retrograde motion, the rapidity of which increases to the period of his opposition to that body. Its speed has now reached its maximum; it soon diminishes, and again appears to stop when it arrives within 152°. Its motion, after having retrograded for 73 days, becomes direct, and in that interval it describes an arc of about 18°. Continuing to approach the sun, it soon plunges into its rays. Mars does not move exactly in the plane of the ecliptic; it sometimes diverges from it several degrees. The variations of his apparent diameter are great; at his conjunction it is 3″, and then he can only be seen with the aid of the telescope. At his mean distance from the sun it is 19″, and at the period of his opposition it is 30″. He is now very brilliant, for only 54 millions of miles separate him from us, whilst at his conjunction he is 264 millions of miles distant. The disk of this planet visibly changes its form and becomes oval, according to his position with reference to the sun, and these phases prove that his light is borrowed from the central luminary. From the spots on his disk, we perceive that he turns on his axis from west to east in 25 h. 31 min., and that his axis is inclined 66° to his orbit. His diameter is a little less in the direction of his poles than in that of his equator, the two diameters, according to Arago, being in the proportion of 189 to 194.

THE TELESCOPIC PLANETS—CERES, PALLAS, JUNO, VESTA.

An idea of Kepler was realised by a discovery of Herschel. If we take the difference between the distances of the planets from the sun, we find a break between Mars and Jupiter. This was remarked by Kepler, who found harmonical proportions in those distances, with the exceptions of that between the two planets we have named. What delight would have filled his heart if he had lived to hear of the discovery of the small bodies which fill up the gap, and to see two new planets placed at the extremity of our system, without deranging the laws of that harmonical theory! To render Kepler's idea intelligible, the reader will understand that the distances of the planets are according to the progression of the multiples of the number 3. Taking the distance of Mercury from the sun to be represented by 4, then the distance of Venus will be represented by 7, that is, 4 plus 3; of the earth by 10, that is, 4 plus *twice* 3; of Mars, by 16, that is, 4 plus *four times* 3; of Jupiter, by 52, that is, 4 plus *sixteen times* 3; of Saturn, 100, that is, 4 plus *thirty-two times* 3; of Uranus, 196, that is, 4 plus *sixty-four times* 3; of Neptune, 392, that is, 4 plus *one hundred and twenty-eight times* 3. It will be perceived that the harmony is interrupted between Mars and Jupiter, where a planet whose distance would be represented by 28, that is, 4 plus *eight times* 3, has not been mentioned.

It must be remarked, indeed, that these numbers are none of them rigorously accurate, but they are so near that astronomers were justified in endeavouring to explain the hiatus that seemed to exist in one part of the chain. On the first night of the present century, Piazzi discovered the planet Ceres. He was looking for a star of the seventh magnitude erroneously set down in the catalogues, and at the spot indicated, he found a very small star, in which, after a few days' observation, he detected motion. This new planet describes its orbit between Mars and Jupiter. Olbers, another astronomer, whilst following up investigations relative to Ceres, soon afterwards discovered a star of the seventh magnitude which he had not previously observed. At the end of two hours, he perceived that it had shifted its position, and, watching it closely, he ascertained that it was another planet with an orbit between Mars and Jupiter. It received the name of Pallas. Olbers entertained the idea that these two planets were the fragments of a larger one, which had been shattered by some unknown cause, and that these fragments, although they had very different inclinations and eccentricities, would yet keep at the same distance from the sun, and, consequently, that their orbits would have common nodes, and would cut them in two opposite points of the heavens. Knowing the inclinations of Ceres and Pallas, Olbers determined these two points to be in constellations Virgo and Cetus. Each part would at every revolution traverse these constellations, and, in order to discover the remaining fragments of the original body, it was only necessary to examine attentively these quarters of the heavens. It was near the constellation Cetus that Harding, in 1804, perceived a star of the eighth magnitude which possessed motion, and proved to be a third planet, since named Juno. Not until the 29th May, 1807, was a fourth planetary body detected. Olbers himself discovered it, and it was named Vesta.

Ceres performs her revolution round the sun in 4½ years; her appearance is that of a nebular spot surrounded by variable mists. Pallas completes her orbit in 11 years 8 months; the inclination of her orbit is 34° 37. She travels further from the ecliptic than any other planet, and to embrace her, the zodiac had to be considerably enlarged. The inclination of Juno is less than that of Pallas, and the time of her revolution is nearly the same. As to Vesta, she is the least of the four, her diameter being only about 90 miles, and she takes only 3⅔ years to travel round the sun. These bodies (which have received the name of the telescopic planets) do not altogether exceed a twenty-fifth of the earth's mass.

JUPITER.

The most brilliant of the planets is Venus, and after her Jupiter; but there are times at which he even excels her in brightness. His orbit is placed between those of Mars and Saturn; it is the largest of all the planets, being 1470 times larger than our globe. His apparent diameter varies with his distance, but it reaches 42″. His distance from the sun is 540 millions of miles, and, viewed from the central orb, his disk would appear 27 times less than we see it, and light and heat are on his surface 27 times less than with us. It takes him about 11 years 315 days to journey round the sun. He is seen in opposition every 399 days, his longitude increasing 30° each time; so that in a year he passes from one constellation of the zodiac into that which is on his left, and in 12 years there are 12 oppositions in all the points of his orbit.

Like the other planets, his course is subject to apparent inequalities. Before his opposition with the sun, and when he is 120° from that body, his motion becomes retrograde, and his speed increases to the moment of opposition; then he moves slower, appears to stop, and when he has approached to within 120°, he assumes his former direct motion. The duration of the retrograde motion is 121 days, and the arc he describes is 11°, but there are sensible differences in the extent and the duration of the several retrograde motions of the planet. His motion is not exactly in the plane of the ecliptic. The time occupied in revolving about his own axis is 9 hours 56 minutes, which is an immense speed for so large a planet. Night with him is almost as long as day, and the longest day is only about five hours. This motion has been detected by observing the spots upon his surface. Since the radius of Jupiter is twelve times greater than the earth's, the space traversed by any given point in his equator is twenty-eight times greater than a point in ours, whilst his rotation is three times more rapid than ours; his centrifugal force is therefore 68 times greater than the earth's, and we are not surprised to learn that the flattening of his poles is so much as $\frac{1}{13}$th, the earth's being only $\frac{1}{300}$th.

Galileo was the first to discover the four bodies which accompany Jupiter. Their configuration changes every moment; they oscillate from side to side of the principal planet, and it is by the extent of their oscillation that we determine their rank, naming that the first satellite whose oscillation is the least. Sometimes they are seen to cross the disk of Jupiter, and to throw a shadow upon him. Hence we conclude that both Jupiter and his attendants are opaque bodies, deriving their lustre from the sun. When interposing between the sun and Jupiter, the satellites form, by their shadow on the planet, eclipses of the sun similar in all respects to an eclipse of the sun by our moon. The shadow which Jupiter casts behind him, affords an explanation of another phenomenon connected with the moons. They are frequently seen to disappear, although some distance from the planet, and the third and fourth sometimes come into sight again, whilst still on the same side of him. This disappearance is similar to the phenomenon of an eclipse of our moon; and the accompanying circumstances are such as leave no doubt on the subject. Thus we always see the satellites disappear on the side of the planet opposite to the sun, and, consequently, on the same side as the cone of the shadow he projects. They become eclipsed nearer him when the planet is nearer its opposition; and, finally, the duration of the eclipses answers exactly to the time which they would take to cross the shadow of a body like Jupiter. The following table shows in the first column the distance in miles of the satellites from Jupiter, and the second, the length of their revolutions round him:—

288,465 miles.	1 day 18½ hours.
459,261 "	3 " 13¼ "
732,336 "	7 " 4 "
1,287,921 "	16 " 18 "

SATURN.

The distance of Saturn from the sun is immense, the radius of his orbit being 996 millions of miles. The plane of his orbit is inclined 2° 31′ to the ecliptic, and the planet describes this curve in 29 years 5 months 14 days, which gives a degree in 30 days. The duration of his synodic revolution is 378 days. His motion is subject to inequalities similar to those of Mars and Jupiter. He becomes retrograde, or ceases to be so, when he is distant 121° from the sun, after or before his opposition. The length of his retrograde motion is nearly 139 days and 7°. Although 887 times larger than the earth, Saturn, by reason of his distance, only transmits us a feeble light, and appears as a star of the second magnitude. The mean of his apparent diameter measures from 18″ to 20″. The sun, beheld from him, would appear 90 times less than he does to us. His polar diameter is less by an eleventh part than his equatorial, and from this we may infer that he turns with great rapidity on his axis. Such is the case; he performs his diurnal rotation in 10½ hours. It is somewhat remarkable, that the two largest planets should differ so little in the time of their diurnal rotations.

Saturn presents a phenomenon unique in the system of the world. He was often seen between two small bodies which seemed to remain with him, and which varied very much in size and figure. Huyghens watched the appearance with attention, and discovered that it was occasioned by a circular ring broad and thin, surrounding the globe of Saturn, but separated from it everywhere. This ring inclined 31° to the ecliptic, is only presented obliquely to the earth, under the form of an ellipse, of which the breadth, when it is largest, is nearly half its length. This ellipse narrows more and more in proportion as the plane of the ring becomes parallel with the plane of the earth's orbit, until the exterior arc of the ring at length conceals the hinder one, and the two are in a line. Those parts of the ring are then only distinguishable which extend on either side of the body; and these parts gradually diminish in breadth until they disappear, when the earth is in the plane of the ring, the thickness of which is too slight to permit it to be seen. The ring becomes invisible also when the sun only illuminates the thickness. It continues to be invisible as long as its plane is between the sun and the earth, and it only reappears when the sun and the earth are upon the same side of this plane, by virtue of the respective motions of Saturn and the earth. That both the ring and the globe are opaque bodies illuminated by the sun is shown by the shadow thrown by the former on the latter, perceptible by the aid of a powerful telescope.

The plane of the ring presenting itself to the sun at every half revolution of Saturn, the phenomena of its disappearance and re-appearance occur every fifteen years. It was invisible last year, and will be so again in 1862, 1891, &c. It turns round the same axis as the globe, and in the same time. The breadth of the plane of the ring can only be given approximately. It is supposed to be about a second, which would be about 4500 miles, about equal to the terrestrial radius, or to a third of the diameter of Saturn himself. Through the void space separating the ring from the globe, stars which are beyond have been seen. On a closer examination, that which seemed to be a single ring proves to be two, concentric and revolving together, but perfectly detached.

In addition to these attendant rings, Saturn has eight satellites revolving about him from west to east in nearly circular orbits. One of these bodies escaped observation until within the last few months.

URANUS.

This body was not ascertained to be a planet, although it had been repeatedly noticed as a star, until 1781, when Herschel the elder discovered its connection with our system. Its distance from the sun is not less than 1986 millions of miles, and its distance from us is so considerable, that only a good telescope will detect it. His year is about 84 of ours, and the sun seems from its surface 400 times less than he does from ours. Six satellites have been seen to attend him, moving in orbits nearly circular.

NEPTUNE.

Every one must remember the noise occasioned by the prediction and discovery of this planet almost simultaneously by a French and English astronomer. Until that time, Uranus was thought to form the out-post of the solar system, but now another star, difficult to discern, to which Leverrier has given the name of Neptune, is believed to be the most distant attendant upon the sun. It is a very remarkable fact connected with this planet, that its existence was theoretically proved before its discovery, and that the calculations of mathematicians in their studies led to the search which terminated in its detection. The perturbations observable in the motions of some of the other planets could not be accounted for except by the supposition that another body, as yet unknown, circulated round the sun, and by its attraction caused the perturbations referred to.

THE COMETS.

The comets are celestial bodies which move like the planets about the sun, but essentially differing from them by the peculiarity of their motions, which are made in all directions, and in excessively elongated ellipses. Some of them describe parabola, (curves of which the greater axis is infinite), and therefore appear only once in our system. They are distinguished in general by their vaporous and semi-transparent tails, through which stars have been beheld. This tail or nebulosity increases as the body approaches the sun, and sometimes an immense train is formed, which attains a length of 90°. They take various shapes; one alarmed the world in the year 400, under the figure of a sword. In 1744, there was one with six tails arranged like a fan, and it was seen to have phases.

The tail of a comet is always turned away from the sun. When very distant from it none is visible, and it appears to be developed gradually as it approaches the solar rays. It acquires its largest dimensions a little after passing its perihelion. It has been supposed that its formation is due to vapours occasioned by the sun's heat. That heat is enormously great at the proximity to the sun to which these bodies reach. The comet of 1680 was 166 times nearer the sun than we are, and the heat in that situation would be 28,000 times greater than ours, the temperature being 2000 times higher than redhot iron. Newton calculated that a globe of iron of similar diameter would retain its heat for 50,000 years.

Comets obey the laws discovered by Kepler, like the other celestial bodies of our system; but it is not to be supposed that it is as easy to calculate their return, as that of the planets, because only a small portion of the arc described by them falls under our observation, and that may belong as well to a parabola as to an ellipse. There are, besides, other causes which stand in the way of our predicting the return of these bodies:—1. The more the ellipse is elongated, the slower is the pace, so that towards its apogee the comet is nearly motionless, and will only return after the lapse of millions of years, or perhaps it may retreat so far as to get entangled in another system. 2. The imperfection of observations made earlier than 1650; this is so great that it has been found impossible to derive data from them for calculating. Besides, a comet may only be visible in southern regions, or be above our horizon during daylight, when it would of course be invisible, though immediately before our eyes. There was a comet which came into our neighbourhood in the 60th year before our era, and it was only observed in consequence of a total eclipse of the sun. 3. The variation in their appearances; a comet which on one occasion is distinguished by its brilliance, returns shorn of its beams, and can scarcely be recognised as the same body without its tail.

The discovery of the laws of attraction opened to philosophers a new heaven. Newton, perceiving the planets to be subjected to a central force residing in the sun, concluded that comets obeyed the same laws in their revolutions; and, in order to explain their long disappearances, it became necessary to assume that their orbits were extremely eccentric, that is, elongated. The comet of 1682 made an astonishing sensation; Newton examined its course; he found that a portion of an elongated ellipse, or what comes to the same thing, a portion of a parabola, answered completely to the observations, provided that one assumed the areas proportional to the times, as in the planetary motion, whence he concluded, that comets are periodical bodies as well as the planets. Halley, starting from these data, calculated all the comets which had been observed up to his time with some exactness, and succeeded in determining their orbits. He found that those of 1581, of 1607, and 1682, resembled one another so much as to lead to the suspicion they were the same comet, completing its revolution in 75½ years. Clairaut took up the calculation, and ventured to predict the time of its re-appearance, and he found that the attraction of Saturn and Jupiter would retard its re-appearance by 618 days. When the comet came, it passed its perihelion within a month of the day named. Later calculations have only been erroneous by three days. At the period of its passing its perihelion, it approaches the sun within $\frac{6}{10}$ths of the earth's distance from that luminary. But at the other extremity of its greater axis, it is at an immense distance, about 35 times the length of the radius of the terrestrial orbit.

There are two other comets of which the epochs of their return have been predicted. The first is that of 1680, calculated by Newton, who attributed to it a revolution of 575 years. The second acquires at each return a slight increase of speed. The mean length of the revolution of this comet, allowing for the perturbations occasioned by the planets in the neighbourhood of its path have been, according to Encke, from 1786 to 1795, 1208, 112 days; from 1795 to 1805, 1207, 879 days; from 1805 to 1819, 1207, 424 days. The comet which approached nearest the earth was that of 1770. It came within 24,000 miles of our globe.

Comets appear to have very little substance or mass, for no derangement has been observed to proceed from their proximity to the planetary bodies. A comet whose mass equalled that of the earth, approaching as near as 26,000 miles, would occasion a tide of 2000 feet, and submerge the four quarters of the globe in 24 hours. The comet of 1770, which came nearest us, occasioned no alteration in the motion of our globe, and no observable effect on the ocean. It was not the 5000th part of the earth, and probably was much less, since it passed between Jupiter and his satellites without causing the slightest perturbation.

The matter of which comets are composed, no less than that forming the planets, will remain for ever unknown to us; we may believe, however, that they are very combustible. Their tails are perhaps formed by the heat of the sun, to which they approach so near, converting part of them into vapour. The evaporable matter of some comets diminishing at each return to their perihelion, may after several revolutions be entirely dissipated, and there will then remain only the nucleus, which may itself lose its solidity.

BUDD'S IMPROVEMENTS IN BLAST-FURNACES.

The prodigious escape of heated gaseous matter from the tops of blast-furnaces has long formed a subject for the deep consideration of practical iron smelters, but only now are promising attempts being made for economising the manufacture, by laying hold of, and applying the waste products to assist in the process whereby they are generated.

At the last meeting of the British Association,* a successful instance of this branch of economy was brought forward by its inventor, J. P. Budd, Esq., of the Ystalyfera Iron Works, Swansea. The brief note of the circumstance, given by us at the time, served no other purpose than a mere chronicling of the fact, which we now propose to illustrate to an extent in some degree correspondent to the magnitude of the discovery.

The value of even a very slight saving in a manufacture of such enormous extent as that of iron, may be conceived upon reflecting that there are probably 1,500,000 tons manufactured in Great Britain per annum. Many furnaces yield from 150 to 200 tons per week, for which 300 or 400 tons of coal are required, and, in these circumstances, from 4,000 to 5,000 cubic feet of air per minute are consumed as blast. In such vast receivers of fuel in a state of combustion, a constant discharge of smoke, flame, and gases, at a heat capable of melting brass, is going on, producing excessive waste of fuel, and an abominable contamination of the atmosphere. This unphilosophical feature has remained unchanged until the introduction of the hot-blast turned the thoughts of smelters towards the devising of some means of making the waste heat available for the purpose of heating the air, which is used at the much lower temperature of 600° Fahrenheit.

The hint, once given, led to numerous schemes; some parties placed a range of iron pipes round the tunnel head, in which the blast was to be heated by the escape gases and flames, or coiled pipes round the interior of the furnace, so as to receive heat from the actual burning materials. Others built blast pipes into the masonry of the furnace, so as to obtain some transmitted heat, without coming in contact with the contents. An official work on the hot blast, published at Freyburg, in 1840, contains drawings of these, and all other plans which have been tried or speculated upon both here and on the continent. A vital objection to the whole of these was, that whenever any derangement occurred, the furnace must be blown out for repair.

The notion of the presumed economy gave an impetus to schemes in another direction, wherein the furnace tops were closed, or partially so, and the gases were collected, and conducted to a receiver, and passed through water for purification and cooling; after which they were pumped off for combustion in a gas furnace. By experiment, it was found that the combustible gases were so diluted with nitrogen, that to burn them in such a state involved two conditions; that an air-blast should be used, and that it should be heated. On ignition, the heat of these gases, carbonic oxide and hydrogen, in combination with carbon, was so intense, that many parts of the furnace were melted. Probably if the plan had been employed, as it is on the continent, for the conversion of pig into malleable iron, in place of adapting it to stoves, it might have succeeded.

Gas furnaces were then thrown aside, and in this state Mr. Budd found the process, when he commenced to experiment upon it, about four years ago. At Ystalyfera, where these trials were made, anthracite coal is used, the production of the furnaces being only 50 or 60 tons per week; and consequently the cost of the hot air furnaces, consuming together 35 tons of coal per week, with the constant attendance of a man, all fell upon this small quantity. The heating stove was built by the side of the furnace, from which it is quite detached, and by a chimney 25 feet higher than the furnace top, as much of the escape gases and heat was drawn in as was necessary.

The arrangement is explained in figs. 1 and 2, which are respectively an elevation and plan of three furnaces conjoined. The ordinary operations of the furnace are not in any way interfered with. A series of horizontal flues, A A, 12 inches in diameter, are formed in the furnace walls, about 3 feet below the top, leading into chambers, B B, each of which has a chimney to produce the requisite draught. These stoves contain ranges of hot-air pipes, C C, upon which the escape gases act in passing through the stoves. The inlet pipe for cold air is at D, whilst the outlets for the hot air to the twyeres are at E E. Iron doors are fitted at F F, for the admission of cold air to the stoves. The cold-blast main is at G, the hot-blast at H.

Fig. 1

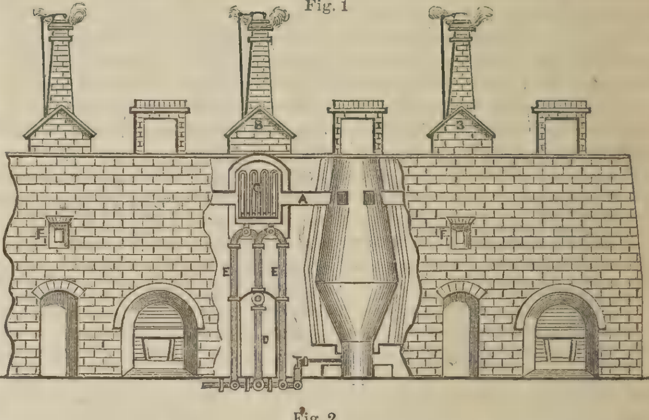
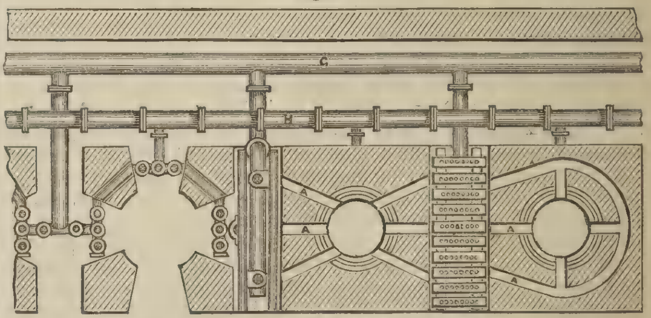


Fig. 2.



1 inch = 12 feet.

The plan view gives a horizontal section of two furnaces to the left, with the hot-air tubes of the stoves, and a ground plan of one to the right, giving the arrangement of the twyeres. By the use of dampers fitted to the top of the chimnies, the supply of gases may be regulated to a nicety. The quantity required for the hot-blast of a furnace, is not more than one-sixth of that which passes off from the furnace. The combustion of the gases is not attempted; they ascend and enter the stove at a temperature of about 1800°, and leave it at 800°; all the heat required, being 600°, their mere passage through, produces all the heat necessary, whilst no injurious effects ensue from combustion. At three feet below the surface of the materials, there is very little combustion; for as the vapours reach the top of the chimney, and come in contact with the atmosphere, a bluish flame, visible at night, bursts out, but is quickly extinguished by the reduction of temperature below that of the combustion of the compound gases. When the materials are allowed to fall below the mouths of the flues, combustion occurs previous to entering the stove, and the vapourous exhalation disappears.

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* Page 163, Vol. I., Practical Mechanic's Journal.

The great feature of this system is the fact of its not requiring any additional coal or labour for procuring a practically good hot-blast, well heated and regular. The first stove of the kind was erected in Nov. 1844, and as it is now in good repair, it is presumed that its action is most economic.

In noticing the objections which have been raised against the plan, it may be here fitly explained, that if the flues are built of fire-bricks, and set not lower than three feet from the furnace top, they have very little tendency to clink; and any loose matter collecting in the entrances, may be easily removed with a rabble. Again, it has been presumed that an injurious deposit of dust will occur in the stoves; but, until this deposit attains a great depth, it occasions no inconvenience, as the surplus supply of available heat is in such excess. On the other hand, the dust is actually serviceable in protecting the pipes, and a stove has worked 18 months without cleaning out or showing symptoms of inefficient action. Should the furnace stop for a short time from any casualty, the damper is lowered, and the stove is closed full of heat, to be ready for action at once. In obtaining the requisite heat upon blowing in a furnace, a cold-blast load is put on for the first day's melting, after which the stove becomes dry, and gives out hot-blast *per se.* If the stove is of green masonry, a small fire is put in at the door, until the draught acts properly through the flues. A curious circumstance occurred in the first stove, where the damper had been left down until the stove should dry; the gas collected until it arrived at the point of explosion, when it blew down the front of the furnace. With the damper up, this can never happen.

For cooling the stoves, when it is necessary to enter them, the doors F F, are provided. The damper being let down, the draught from the furnace is stopped, whilst the stove door is opened to admit cold air.

In the six furnaces at Ystalyfera, of which we have shown three in our engravings, the whole are placed in a row, and joined together by arches—and upon these arches, the stoves, five in number, are erected, each stove being between two furnaces, with pipes from each.

The saving involved in the process is calculated by Mr. Budd at 33 tons of anthracite at 4s., the attendance of two men, and wheeling coal and ashes, £2, the total being £8, 12s. per week, without calculating the economy in the repairs of stoves.

Not only is the gaseous escape rendered valuable in the way we have mentioned, but it is further applied in raising steam for the engine. Not more than one-sixth of the escape is really employed in the smelting process; but even this fraction does the work of from 10 to 35 tons of rubbly anthracite coal per week, burnt in the common reverberatory furnaces, whilst the remaining five-sixths are suffered to escape into the open air. In applying a portion of this lost matter for raising steam, two flues, 24 inches diameter, were formed, leading into a main flue, 32 inches diameter, connected with the tube of the nearest steam boiler, the distance from the furnace to the boiler being 46 feet. The boiler tube is divided by a brick partition into two compartments, the heated vapours passing four times through and beneath the boiler, the aggregate flue passage being 120 feet. The chimney is 6 feet diameter, and 80 feet high, having a very strong draught, which takes off the gases from the furnaces, and fills the boiler with the heated vapours. The whole 46 feet of flue between the furnace and the boiler is carried on supports like a bridge, through the open air, still, in the face of the loss from cooling, the boiler now raises twice its former quantity of steam, and the resultant saving on this head alone is equal to 35 tons of coal per week. It is in contemplation to use the furnace vapours alone, in raising steam, so as to be totally independent of coal, excepting for starting with.

The following is the result of an analysis of the gaseous escape at Ystalyfera, made by Dr. Shaufhetel. The subject of analysis was taken off at 16 feet below the surface of the coal and mine in the furnace:—

Carbonic acid,	00·136
Carbonic oxide,	18·974
Hydrogen,	27·844
Light carburetted hydrogen,	3·212
Sulphurous acid, with traces of arsenicated and phosphuretted hydrogen,	a trace.
Nitrogen,	49·844
	100·

At a foot only below the surface of the coal and mine the analysis is:—

Carbonic acid,	9·546
Carbonic oxide,	12·012
Hydrogen,	21·278
Light carburetted hydrogen,	2·548
Sulphurous acid, with traces of arsenicated and phosphuretted hydrogen,	0·111
Nitrogen,	54·505
	100·

About three feet below the surface of the materials, where the supply is taken from the furnace, the gases are little changed from their original condition. It is rather peculiar to find so large a quantity of hydrogen in the analysis, as we know that anthracite contains only 2 or 3 per cent., and the flame, as seen at night, is very different from that issuing from furnaces with bituminous coal, being of a bluish-white tint. It would appear, from the absence of carbonic acid in the first analysis, and its presence in the second, that the solid carbon of the fuel, after conversion at the twyeres, into carbonic acid gas, by combustion with the oxygen of the blast, passes upwards into the central portion of the furnace, where it meets with carbon in excess, and absorbs an additional portion of it, being thus converted into the combustible gas, carbonic oxide. As at least one half of the escape is combustible, and no other use is made of it, than as a simple heating medium, no obstacle exists in the way of its subsequent use as a combustible, in proper furnaces, so that the economy of the principle is not yet pushed to its fullest extent. Whilst in reverberatory furnaces the proper action is utterly dependent upon the maintenance of a good draught, and the combustible gases—these also in excess—must pass freely off, to allow a good supply of air to enter the grate in blast furnaces, where the dependence of the action is upon the power of the steam engine, as applied to force a column of air through 40 feet of materials, and in the latter case there is nothing to prevent the securing of the whole supply.

If we are to carry out the theory to its full capability, the existing arrangements of iron-works must undergo a radical change. The steam-engines and boilers for the blast, forge, and mill, must be elevated above the back wall, whilst the stoves are alongside the furnaces. The steam must be raised in the boiler, and the air heated in the stoves, simply by the passage of the gases from the furnace to the gas furnaces, where all the processes of conversion, refinery, boiling, puddling, and balling, should be carried on.

From calculations made with reference to experienced effects, it is supposed that the consumption of about two tons of fuel will suffice for the entire conversion from the ores into malleable iron, where six tons are now used.

Mr. Detmold has put a gas-furnace into successful practice at Yniscedwyn. But here the gas is not obtained from the blast furnaces, but from a species of double furnace, in which they are generated by a blast of air injected into the ash-pit, whence it is passed through the coal in the grate, and combustion is effected by forcing in numerous small streams of heated atmospheric air. This plan has been also successful in the anthracite districts of the United States. The Yniscedwyn furnace is for refining pig-iron, or converting it into what is technically known as "metal." Although the loss of metal in conversion is very little, yet the iron produced, is dull in appearance, and possessing little of that silvery hue by which the quality is usually judged.

Should Mr. Budd's system ever be practised to the extent at which we have hinted, there is little doubt but that the conversion of ore into malleable iron may be performed by the coal put into the furnace, alone, effecting an economy of not less than 5,000,000 tons per annum, or, in money, £1,000,000 sterling.

THE RIVER CLYDE.

Harbour and Railway Improvements.

Illustrated by Plate 27.

The Clyde, Scotland's canal-river, may certainly be ranked as the greatest monument of her perseverance. Throughout the whole of Great Britain no parallel example of successful engineering, under such extraordinary circumstances, can be shown—no such magnificent result from an origin so insignificant. In recapitulating an engineering history like this, we find, at every point of examination, the most interesting examples of foresight, of ingenuity, and of persevering diligence.

Up to the year 1700, it appears that the burgh of Dumbarton held the governing reins of the river, which, according to the account of the citizen historian, M'Ure, in 1736, was a streamlet frequented only by barges and lighters. In 1758, the first Parliamentary Act for its improvement was obtained, and according to the provisions of this Act, it was in contemplation to procure a greater depth of water, by the construction of a lock at Marlin Ford. Fortunately, no lock was ever made, and little movement was made until the year 1770, when a second Act was passed: the trustees having, by this time, found out that by contracting the channel, building jetties, and dredging, the bed might be so far improved as to produce seven feet of water in every part, at neap-tides, without a lock.

In 1809, a third Act was obtained, for the purpose of securing authority to extend the depth to nine feet at neap-tides, and after its provisions were fulfilled, a fourth was procured in 1825, followed up by one of 1840, the plan for which was by Mr. Walker; under these powers the navigation has been brought to its present perfection.

In Smeaton's Report of 1755, we have a lucid account of the then state of the river. Quoting the language of the Report, we find—" 1. That on September 3, 1755, being the third day after the equinoctial full moon, the river low after a drought, and the wind easterly, the Clyde was sounded upon twelve different shoals between Glasgow and Renfrew, both at low and high water. The two shoalest places were at the Hirst, a little below Glasgow, and Point House Ford; the former having one foot six inches, and the latter one foot three inches at low water. The soundings at the three lowest shoals—*viz.* Marlin Ford, Blarthill Sand, and Spoydoch Ford, near Scotstown—were one foot six inches each. At high water, the same day, Spoydoch had six feet, Blarthill four feet nine inches, Marlin Ford four feet nine inches, Point House Ford three feet eight, and the Hirst three feet three inches.

" 2. The declivity of the river appeared very gentle even upon the shoals, and almost stagnant, as to appearance, at the deeps.

" 3. That Marlin Ford is the only firm ground between Point House Ford and Spoydoch.

" 4. That the river at Marlin Ford is not more than 684 feet wide.

" 5. That the river at Spoydoch is 884 feet wide.

" 6. That the ordinary neap-tides are sensible at Glasgow Bridge.

" 7. That at Marlin Ford the ordinary neap-tides rise two feet, so as to make three feet six inches depth of water there.

" 8. That at Spoydoch the ordinary neap-tides rise two feet six inches, so as to make four feet water there.

" 9. That at Marlin Ford the shores are bold and full, particularly on the south side.

" 10. That at Spoydoch the shores are flat and low, particularly on the south side.

" 11. That Blarthill Sand is a ridge of quicksand, of small extent.

" 12. That Spoydoch Shoal is a ridge of hard gravel, of small extent.

" 13. That the pool or deep between Marlin Ford and Blarthill Shoal contains a sufficient depth of water to keep up such vessels as usually come up the Clyde afloat at low water.

" 14. That from Point House Ford to Marlin Ford is almost one continued shoal of light sand.

" 15. That the navigation is free, at ordinary neap-tides, as far as Spoydoch Shoal, for vessels that do not draw above four and a half feet water."

Hence, he decided that to secure the modest depth of four feet and a half at the Glasgow quay, a lock should be made at Marlin Ford, a little above Scotstown, some four miles below Glasgow Bridge. It is lucky indeed, that this lock was never constructed, for the time lost in passing it, would be pretty near equal to that of the entire passage to Greenock.

In 1768, Mr Golborne was employed in surveying the river, with the view of carrying on the deepening, and improving the harbour of Port-Glasgow. This engineer appears to have at once taken the right view of the case, for he remarks in his Report, that " the river Clyde is at present in a state of nature, and, for want of due attention, has been suffered to expand too much; for the sides in most places being much softer than the bottom, the current has operated there, because it could not penetrate the bed of the river, and has, by that means, gained in breadth what is wanting in depth." At Dumbuck Ford, where there are two channels, the re-flowing current was greatly weakened, and as the bottom was covered with hard gravel, it could not be worn down to a proper depth. To remedy this, he proposed to construct a jetty from Longoch Point, over the south channel, to confine the current, and to dredge away the hard gravel, so as to permit the re-flowing current to act with greater force to increase its channel.

Subsequently, Messrs. Watt, Rennie, Telford, Whidbey, Hartley, and Walker, have each been retained to give advice, as to the successive improvements, which have been carried out under the immediate superintendence of Messrs. Spreull, Atherton, Logan, Bald, and Bremner, and given us a high-water depth of 18 feet at the Glasgow Harbour. Our Plate exhibits, in two lengths, the present condition of the whole river, from the Glasgow Harbour, down to the Red Light, below the Tail of the Bank, near Greenock, with the valuable soundings of the frith, from Ardoch, down to deep water at the Tail of the Bank, taken by Captain Robinson in 1846, marked upon their exact positions.

The new wet dock, to be constructed in Windmill Croft, on the south side of the river, is given at A. It will be six acres in area, providing about 2,500 lineal feet of quayage. B C, Are the two proposed Stobcross docks, on the north bank; the entrance-basin, B. is to be 4¾ acres in extent, with 1,752 feet of quayage; and the inner one, C, will be 12¼ acres, with 3,520 feet of quayage. At the point, D, a new quay wall is now being made, of which 1,200 feet are to be appropriated as a mineral wharf for the General Terminus Railway Company, by whose assistance the river has been put in complete connection with the Polloc and Govan Railway, now the property of the Caledonian Railway Company. By this arrangement the Clyde will shortly possess the best facilities for the shipment of minerals directly from these lines, rail-tracks being laid along the edge of the new quay wall, with several powerful hydrostatic and steam-cranes. Our next paper on this subject, to be given next month, in connection with detailed plates of the harbour and railway arrangements, will show what has been done to give to Glasgow the most complete facilities for a conjoined water and railway transit.

The strong dotted lines on each side the water-line of the river explain the position of the proposed walls to be constructed for straightening and generally improving the water-course.

The plan of Mr. Walker, who is now the consulting engineer to the River Trustees, is to straighten, generally, as well as to widen the channel of the river, as is shown on our plan, by cutting away all impeding projections, giving a gradually increasing width from just below the harbour downwards, carrying out the principle of parallel dykes, the object being, in giving the course this funnel shape, to obtain a free run of the tide, and a higher flood-tide at Glasgow. These operations are now carried on under the superintendence of David Bremner, Esq.

By constructing parallel dykes, and an active system of dredging, we believe that generally a channel in the centre of the river of 70 yards wide has been deepened on an average 12 feet over a distance of 2½ miles; a channel 90 yards wide has had 6 feet added to it over 2½ miles; and another of 100 yards wide has been deepened 6 feet for a distance of 1¼ miles. The same width and depth has been cut through the Port-Glasgow bank; the Garmoyle bank has also been cut through, and an extensive harbour has been made at Bowling; and lastly, the river has been lighted and perched throughout.

Comparing the present condition of the river with that given in Smeaton's Report, it would be unjust to lay any stress upon the large sum expended, which, up to June 1848, was £1,539,646 18s. 10d.; for who, in the earlier stages of improvements, could have even approximately foretold its ultimate perfection? Besides, a great part of this expense has been incurred in purchasing land, and had nothing whatever to do with the works.

As a summary of results, it may be stated that the revenue, in 1848, reached the sum of £60,621 8s. 1d.; the number of sailing vessels being 5,869, amounting to 364,198 tons; steam-vessels, 9,079, amounting to 851,230 tons.

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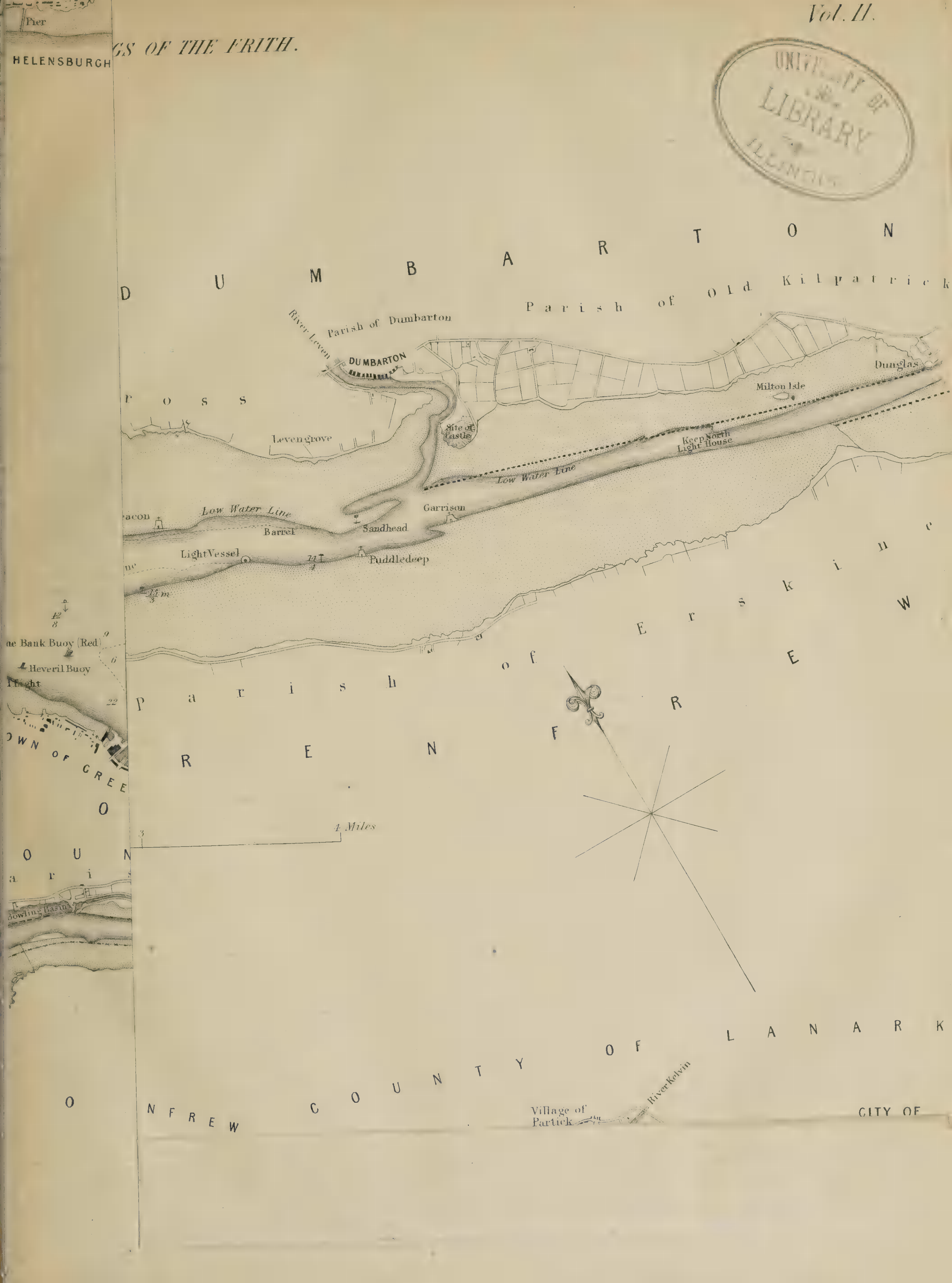

THE RIVER CLYDE,

WITH THE LATEST IMPROVEMENTS, AND THE SOUNDINGS OF THE FRITH.

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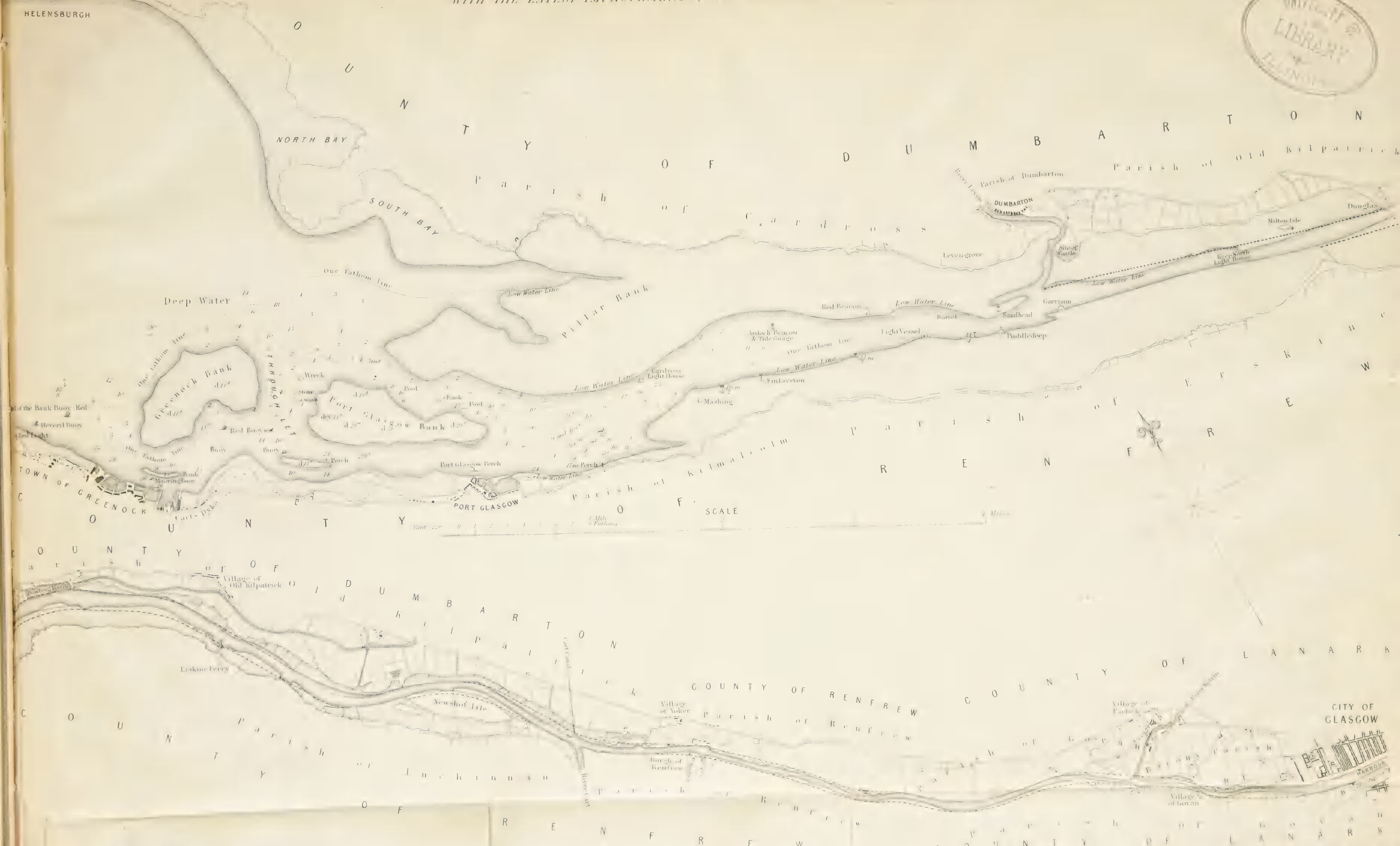
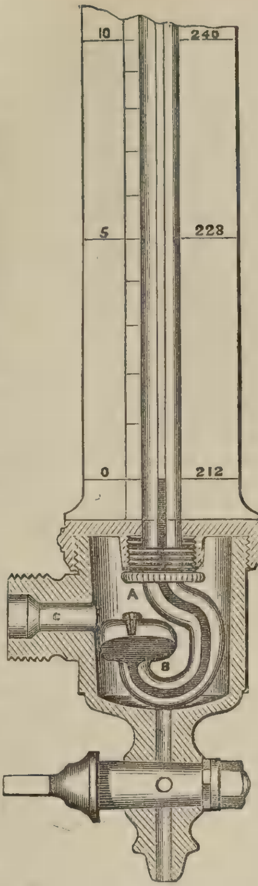


NEW STEAM PRESSURE AND BAROMETRIC GUAGES.

We are glad to see any signs of improvement upon the barbarous contrivances often made use of in registering the important points of steam and vacuum pressure. Messrs. Frost, Noakes, & Vincent, of Whitechapel, London, have recently registered a neat and accurate arrangement of the kind, which appears to fulfil all the necessary conditions in reference to accuracy, whilst it embodies considerable elegance of appearance. The annexed engraving is a half-sized vertical section of the shell of the steam-guage, with the mercurial tube and index-plate in elevation. A, Is the brass shell or case for holding the bulb, B, and the bent end of the mercurial tube, which is passed through a small stuffing-box or steam-tight lid, formed in the circular end cast on the bottom of the index plate. The latter is screwed upon the top of the shell, for which it answers as a cover.



The steam enters the case, A, by the branch, C, and finds its way to the surface of the mercury in the bulb by a small opening at the top. This opening has a short tube projecting inwards, so that any disturbance of the vertical position of the guage will not throw the mercury out. A stop-cock, forming the finish of the case, allows of any accumulation of water being drawn off. The scale is graduated on one side in pounds of pressure per square inch, and on the other in degrees of temperature corresponding to such pressures.

The barometric guage is of the same size and general appearance, but the opening to the condenser is by the bottom stop-cock. The vacuum is measured by graduations on each side of the glass tube, commencing at 15 inches, and reading downward, on one side, so far as 29; whilst on the other, the amount of vitiation is shown. The tubes are sunk pretty deep into a recess cast in the index-plate, and, to show the indications clearly, a red tint is given to the bottom of the recess, so as to contrast well with the light shade of the mercurial column.

RECENT PATENTS.

COTTON MACHINERY.—J. Metcalf and R. Halliwell, Little Bolton.—*Enrolled Feb.* 8, 1849.

The first of these improvements is a stop-apparatus for roving or similar machines. The rovings are passed beneath the end of a nearly equiposed lever, against which they press, upon entering the feed rollers. When a break occurs, one end of the lever falls, and detaches a stop, allowing a weight to fall over, and throw the driving strap upon the loose pulley. This contrivance is, in fact, essentially the same as the weft protector fork, used in stopping looms, when the weft thread breaks.

A second improvement refers to a peculiar steel spring presser for roving and slubbing bobbins, the curvature of which spring is so proportioned as to give a continuous uniform pressure to the roving at all parts of the filling of the bobbin. In a third part of the invention, an eccentric mangle wheel is proposed to be employed for elevating the bobbin rail, in place of the heart contrivance now in use, and a fourth branch involves an arrangement of gearing, for winding the roving upon the bobbin, that it may be removed without reversing the movement.

Several other improvements are embodied in the eleven claims, which we have not space here to enumerate.

STEAM-ENGINES.—J. Simpson, and G. A. Shipton, Manchester. *Enrolled Feb.* 14, 1849.

The improvements in the steam-engine are,—Firstly, The application of an oblong steam-case, containing a piston, set eccentrically upon a shaft carried in moveable bearings set in side rods, having cranks at the ends, fitted with connecting-rods proceeding to the driven shaft. The ends of the piston are kept steam-tight by spring wedges acting upon bevelled rings. Steam is admitted by an opening in the side of the cylinder, and is conveyed by passages above and below the piston. Opposite to the steam-ports, in the side of the cylinder, is a recess fitted with a plate, having springs keeping it up against the piston. A governor is also included in the improvements; it consists of a vase with an internal cylinder partially filled with water, having a screw in the centre. A tube passes through the screw, and through a water-tight opening in the vase bottom, and above the water level. A rod is set in this tube, resting upon a bearing beneath the vase, fitted with a bevel-wheel by which it is driven from the main-shaft. This rod has a fixed feather, on which the screw rests; and at the top it has a collar, between which, and the collar on the screw, a spiral spring is coiled upon the rod. The top screw collar has a groove, in which is placed a loose collar with projecting studs, gearing with links on the end of a lever. As the screw increases or diminishes in speed, it will ascend and compress the spring, thus elevating or depressing the free end of the lever. The claims are, the constructing of a steam-engine with an eccentric piston reciprocating in a steam chamber, of the same diameter as the piston's width, the axes of the piston being capable of moving a distance equal to the piston's eccentricity; also, the application of bevelled rings for packing the slides.

The using a revolving spiral enclosed in a chamber containing water, and applied as a governor.

The constructing of sliding cut-off valves having a butterfly throttle-valve in the back, worked by a spindle passed through the main spindle, having a stuffing-box at the top. Also, the mode of protecting the joint faces from the injurious action of the steam, by having a first portion to regulate the passage of the steam, and a second to cut it off finally.

ORNAMENTAL SURFACES.—T. De La Rue, London. *Enrolled Feb.* 15, 1849.

Mr. De La Rue's invention refers to a very clever application of the iridescent tints of thin glass-plates, and films of liquid, known as "Newton's Rings;" as also the tints given out by heated steel, or polished iron immersed in a solution of acetate of lead, and connected with the positive pole of a battery, whilst the negative wire is dipped into the solution.

The article to be ornamented, is placed in a shallow vessel, filled with water to a depth of four inches above the surface to be tinted, and a spirituous solution of a resin or balsam is added in sufficient quantity to cover the water and impart to it the iridescent play of colours. When the solvent evaporates, leaving the film firm, the article is gradually raised in a sloping direction, so that the water may escape from the film, which attaches itself to the surface in operation, and is set out to dry. When the surface is irregular, the article is set in a perforated false bottom, and is lifted out in an inclined direction. In the case of a statue or similar figure, it is suspended by a wire, and made to revolve during its withdrawal from the liquid, or the latter may be run off at the bottom. Different tints are attainable by dropping the colouring solution in drops upon the water, and passing the teeth of a comb through them, as in marbling. The patentee employs clear water as the supporting medium, and hard white varnish, mixed with equal parts of spike lavender oil. Claim is general.

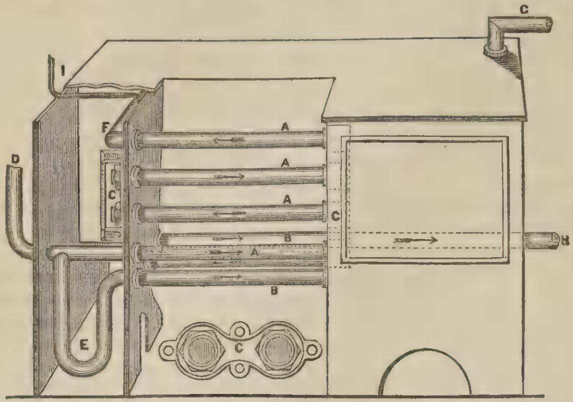
REGISTERED DESIGNS.

ECONOMIC HOT WATER APPARATUS.

Registered for Mr. Andrew Bertram, 75 *Mitchell Street, Glasgow.*

This design has reference to the warming of apartments, as also to the heating of water for domestic purposes, and consists of such a configuration of the bars of a fire-grate, that a current of water shall constantly circulate through them, and become heated for the various uses of baths or culinary processes. Our engraving represents the apparatus as embodied in an ordinary kitchen fire-grate. The four front bars, A, as well as the three bottom ones, B, are tubular, their ends passing through the cheeks of the grate to coupling boxes, C C, on the outside. The ends of the bars open into these boxes, to which they are attached by nuts. In this way a thorough communication is formed throughout the series.

The coupling boxes, C, are of the form shown in the detached figure, which is a plan of a single box, looking into the hollow. Projections are cast on each box, by which to screw on a cover. The cold water supply arrives by the pipe, D; it communicates with the end of the lowest of the four front bars, A; and by the curved pipe, E, with the first of the three bottom bars, B. The course of the current is indicated by the arrows; the water passing through the front bars is discharged in a heated state, by the highest of the series, into a connecting pipe, F, leading to the boiler at the back of the grate, whence the water is delivered for use. By the pipe, C, the current passes similarly along the bottom bars, B, and is delivered by the pipe, H. A small safety pipe is placed at I, to prevent dangerous consequences in cases of overheating, or the accumulation of superfluous steam pressure. The top of this pipe being carried up somewhat higher than the intended level of the hot-water current, any pressure beyond that due to such a height of column will cause an overflow at I, as an indication of danger.



Hollow fire-bars for a circulation of water have been long ago tried in steam-engine furnaces, and given up as unmanageable, and unfitted for their purpose, but this is the first attempt to apply the system for the uses of the kitchen, where it is found to be a most valuable apparatus, as well in economising fuel, as in hastening the production of that most necessary article—hot water.

REVIEWS OF NEW BOOKS.

A Manual of Writing and Printing Characters for Architects, Engineers and Surveyors, Engravers, Printers, Decorators, and Draughtsmen. By B. P. Wilme. London: Weale.

Reform in the routine of the drawing office is distinctly marked in Mr. Wilme's pages, a perusal of which tells us that he has not omitted to set about practically what he has professed to teach.

In his preface, he tells us truly enough, that an examination of the writing on the majority of our plans, shows that we are sadly deficient in this branch of the surveyor's art, and lays down the following reasons of such deficiency:—

1st. Our ignorance of the *analysis and construction* of letters, and our want of proper training thereto. 2d, Our want of taste in the *selection* and *arrangement* of proper characters to distinguish the different parts of maps and plans; and 3dly, our too frequent habit of copying from our neighbours, instead of understanding how to proceed for ourselves. No one will dispute the truth of these remarks; for, in all varieties of printing characters, we find different constructive principles in almost every map which comes before us.

Beginning at the very foundation of the subject, Mr. Wilme gives, in his first plate, a complete analysis of the "construction of round-hand characters," furnishing guide-lines for the angle, and width of every letter. This reduces the matter to pure system at once. He advocates (for some general purposes) the use of copper stencil plates, for lettering, or forming portions of letters, where it is not of much consequence to have more than a certain degree of neatness. But perhaps the most useful plate in the whole twenty-six, is that in which he gives "the true method of forming titles for maps and other pieces of writing." The system upon which this is laid down is admirably practical. The title is first written out in ordinary round hand, in the number of lines which it is intended to occupy. When this is done, the number of letters in the first line is counted, and, the lines which the finished title is intended to occupy, being marked out in another place, in pencil, the centre letter is put on the perpendicular centre line of the space it is intended to cover, the remaining letters being worked off to each side, so that there is no possible chance of their being the least out of balance. Each line is thus constructed, until the whole is finished.

The remaining plates, which are very complete and well finished, are mostly devoted to examples of all the varieties of characters which the engineering draughtsman adopts. We cannot close our notice of the book without congratulating Mr. Wilme upon having been the first to arrange and systematise a code of instructions on a point of much material importance to all who are in the habit of preparing and finishing plans.

Companion to the Improved Log-Book for Steam-Vessels. By Peter Borrie, Engineer. Pp. 26. London, 1849.

This book, which is fitly dedicated to the chairman and committee of Lloyd's, aims at the reformation of a very important feature in the routine of marine steam-engine management. It is essentially necessary that, in addition to the ordinary sea-log of steam-vessels, a correct register should be kept of the performance of the engines during a voyage, and for this purpose it is usual for the engineer to keep a log of his own. These engineers' logs, however, are generally of a rough unsystematic class, and many particulars of vast importance are wholly neglected in them—hence, the appearance of Mr. Borrie's production as an improvement of some consideration. It is formed in two distinct parts, printed on opposite pages—one for the chief engineer, the other for the chief officer; so that whilst there are really two separate and distinct books, the chief officer can at any time obtain any particulars from his engineer's registries. Blank sheets of the log are also provided separately for the convenience of transmission of any particulars through the post, when the ship, whose proceedings they register, is at a distance from head-quarters. The first column of the pages contains the hours numbered from 1 to 12, opposite to which are set, in consecutive order, columns showing particulars of the number of fires in use; the indications of the steam-guage; the amount of expansion; state of the barometer at condenser; the thermometrical indications of the atmosphere, and at the hot well; number of revolutions of paddle or screw-shaft, with particulars of such propellers; the amount of slip, and the distance run. The bottom of the page has a portion allotted for the details of coals, oil, tallow, rope-yarn, with the number of hours steaming and sailing, and the forward and aft immersion of the ship.

The chief officer's log, on the opposite page, is similarly arranged for noting all the necessary points of observance coming within his scope. In the "Companion," a vast amount of information on the management of the engine and boilers, with practical notes for use in emergencies, are given; and, in addition, a series of tables of the force of the wind, area of principal sails, expansion, velocity of screw-propellers and paddle-wheels in knots and fathoms per hour, and others. We must make this summary of the contents of the book answer as our notice for this month. In our next part we shall avail ourselves further of the information which it contains.

A Portion of the Papers relating to the Great Clock for the New Palace at Westminster, Printed by Order of the House of Lords, with Remarks. Pp. 56.

We notice this pamphlet here merely as a record of its existence; for it is mainly confined to an account of some misunderstandings between Mr. Vulliamy, Mr. Dent, and Mr. Whitehurst, three of our most eminent clock-makers, in reference to the construction of the new clock for the Houses of Parliament. With professional disputes of this nature the public have little to do; but as the book does really contain a good deal of information on the construction of turret clocks of large size, and as it owes its origin to the fact of the construction of perhaps the finest specimen of clock-work in the world, we shall again refer to it for the extraction of some of the interesting matter with which it abounds.

CORRESPONDENCE.

RAILWAY SIGNALLING.

Your Journal of the past month contains another of the many schemes already proposed for rendering possible the communication between the guards of a railway train and the engine-driver. Many of these schemes are very elaborate, but too complicated and expensive. Strange, that many, amongst them your correspondent W. K., take the trouble of inventing an air-whistle, or other sound-producing apparatus, and forget that every locomotive is supplied with one ready made to their hands, and that it is only necessary to establish from the guard's seat a connection with the steam-whistle.

The plan I am going to describe is not a new one; it is one which I constructed on a railway many years ago, and I shall show how it can be adapted to peculiar circumstances, so as to render it in a manner self-acting.

I was formerly engaged on a foreign railway as superintendent of the engine department, where it was required by the authorities that a ready means of communication should be established between the guards and drivers, to enable the former, in case of accident, to give timely warning to the latter.

I must premise, that on this line the guards were placed on the outside and top of the carriages.

The means of signalling which I employed was the steam-whistle on the engine. The way the guard had access to it was the following:—Into one side of the outside fire-box a stud was screwed, upon which a small bell-crank was moveable, the arms of which were about 3½ or 3¾ inches long. Another and similar bell-crank was in the same way fastened to the back frame of the tender. To this latter bell-crank was attached a rod of strong iron wire, which, passing underneath the tender supported by guides, was at its other end fastened to the first bell-crank by means of a hook, so that, on separating the engine from the tender, the rod could be easily unhooked. The other arm of the fire-box bell-crank was connected to the handle of the steam-whistle, by a rod of wire or a slight chain, which, to follow the bend of the top or dome of the fire-box, passed over a small guide-pulley. A strong hemp line was now stretched over all the carriages, descended in front of the first, and was attached to the bell-crank, described as being fastened at the back of the tender. To render it easy to detach this rope, it was furnished with a long hook, whose opening was closed by a strong spring.

It is plain that a slight pull at the line, even at the farthest end of the train, would cause the steam-whistle to give out its strong warning sounds, and thus inform the driver that something was wrong, and cause him to stop the engine. Again, by employing a chain as a connection between the whistle-handle and the first bell-crank, the rods, &c., are not moved when the engine-man blows the whistle, the chain being then merely slackened.

I have seen this arrangement in use for several years, and in all seasons and weathers, winter and summer, in the severest snow storms, not one single case has happened where it proved ineffectual; whereas, many an accident has been prevented or rendered comparatively harmless, through the guards (who, from their position, were continually watching the train) being able to give timely notice to the engine-man.

Now, on many English railways, the guard being closed up in his van, has no opportunity of watching the train; and in the case of accidents, such as the breaking of an axle, a carriage getting off the rails, a fire breaking out, the passengers and carriages are left to take care of themselves till the arrival at the next station, or till the damaged waggon acts as so powerful a break upon the whole train, that the engine-man is forced to perceive "something is wrong." Also, a coupling-chain may break, and some carriages may be left on the line; which, where trains follow each other quickly, may lead to disastrous consequences.

Under such circumstances, the above simple arrangement must be made self-acting. But how? Let a rod of strong iron wire be passed underneath the foot-board of each carriage, the same length as the carriage, and sliding in guides fastened to the foot-board. At each end of the rod let a slight chain be fastened, terminating in a hook like those described above, the chain having a length equal to about half the distance between two carriages, when arranged in a train.

Then, in every train these rods, by means of the intervening chains, are hooked together, and the rod of the first carriage is hooked to that passing beneath the tender. Suppose now an accident occurring, such as an axle breaking, carriage getting off the rails, &c., then, as the position of such carriage, and with it, of the signal rod, is changed with regard to the rest of the train, a strain will be produced upon these coupled rods sufficient to give a pull at the bell-crank on the fire-box, and sound the whistle. The same effect is produced on the giving way of the coupling-chains between two carriages, when those that are loosened are gradually separated from the forward part of the train.

Wherever the guard-van is so constructed that the guard can overlook the train, it is well to place at some convenient part another bell-crank, connected on one side with the signal-rod, on the other, to a rod passing upwards to the guard's seat; then the passengers will have the means of informing the guard when something is wrong, by the waving of handkerchiefs out of the window, or of small flags (on some railways one is placed in back compartments of a carriage for this purpose).

From practical and personal experience of this plan, I propose it as an easy, effectual, and self-acting means of signalling to the engine-man. It is so very simple and cheap, that railway companies, or rather directors, ought to be blamed if they do not employ it; always excepting they can adopt a still better and more effectual plan. The whole arrangement can be made and fitted to an engine and tender for, at the utmost, about 25 shillings—a trifling expense considering the danger to persons, and the more than necessary damage to materials, resulting in such cases as that mentioned by your correspondent W. K., from Blackburn, merely from inability to give timely warning to the engine-man.

I shall be happy if you consider the above communication worthy of a place in your valuable Journal.

Bradford, February 21, 1849. T. Passavant, C.E.

THERMOMETRIC OBSERVATIONS.

I have no wish to break a lance with H. R. in mathematical polemics, but simply to show at first that mathematicians, as well as others, are liable to fall into error. In suppressing what he has termed the circular multiplier ·5236, he has actually suppressed what represents the volume of mercury in the bulb, when at the temperature of zero, and by which the result showing the error, would be increased nearly double, or exactly as ·5236 to 1.

We will at once go into the true merits of the case. The universal doctrine of natural philosophy is, that equal increments of true temperature (within certain limits) produce equal increase of volume of all liquids, notwithstanding the experiments of Dulong and Petit, who, by using a defective measure of temperature, have shown a small deviation from the universal rule.

In the exercise of what appears sound reason, and discarding from consideration the result of Petit and Dulong's experiments, I will show the amount of error in the scales of Celsius and Fahrenheit, between the freezing and boiling points of water, when H. R. will find, that my first purpose was not to split straws for nothing; or to exhibit a long train of figures, but to point out a gross defect in the graduation of their scales.

First, when the stem of a thermometer is of equal diameter if round, or of equal sectional area when of any other figure, throughout its length, the degrees marked on the scales of Fahrenheit and Celsius are equal spaces.

Second, taking the lineal dilatation of glass and of mercury in volume to be uniform from the freezing to the boiling point of water, I say,

Let $m =$ the dilatation in volume of mercury from zero of the centigrade scale, when its temperature is increased one degree, the volume at zero being 1.

$g =$ the lineal dilatation of glass when its temperature is increased one degree, its length at zero being 1.

$n =$ any number of degrees on the scale of Celsius above zero.

$a =$ the cubical content of a sphere of the diameter 1.

Then $(\overline{m+1} - \overline{g+1}^{3})\ a = m'$ the volume of mercury in the stem, when the bulb, stem, and that mercury within, are at 1° C.

$\dfrac{m'}{m+1} = m''$ the volume of mercury in the stem, when the bulb is at 1° C, and the stem surrounded by the air at the temperature of zero.

$(\overline{m\,n+1} - \overline{g\,n+1}^{3})\ a = m'''$ the volume of mercury in the stem, when the bulb and stem are both at the temperature of (n) degrees.

$\dfrac{m'''}{m\,n+1} = m''''$ the volume of mercury in the stem when the bulb is at (n) degrees, and the stem and its contents at zero.

$n - \dfrac{m''''}{m''} = e$ the error of the scale of Celsius when the bulb is at the temperature (n) degrees, and the stem and its contents at zero.

$e \times 1{\cdot}8 = \mathrm{E}$ the error of the scale of Fahrenheit, when the bulb is at (n) degrees, by the scale of Celsius, and the stem at 0° C. or 32° F.

By the foregoing formulæ, when $m = {\cdot}00018$, — $g = {\cdot}000008$, — $n = 100$ and $a = {\cdot}5236$,—the error by the scale of Celsius, when the bulb is at 100° C, and the stem at 0° C, is 1·7624 degrees; and the error by Fahrenheit 3·17232 degrees.

H. R. has already admitted some truth in the principle adopted, and only cavils with me, because it will not carry me safe through sixteen decimal places. I need not now inquire if he will admit eight sound places, six only, one, or none. But he has said "it is singular that a calculator of such minute accuracy should have failed to notice, that the diameter of the tube, as well as the diameter of the bulb, is smaller at low than at high temperatures, and if he had applied the necessary correction in this respect, the error which he details in the *seventh decimal place*, would have been diminished to a still more microscopical degree of tenuity, or perhaps have vanished entirely."

This gratuitous assertion has been disproved, and if H. R. can convict either the formulæ or figures of error, I challenge him to do so.

His arguments against me, taking them as a whole, have seemed rather designed to captivate the superficial reader, and to sink my acknowledged small acquirements into nothingness, than to try the fair merit of the question at issue between us. His distinction between the circular multiplier ·5236, and that which he has substituted in sixteen decimal places, is of a nature so captious as not to require a comment, excepting that he has not played the fair game, first, in showing the result would be the same when the circular multiplier is suppressed, and then proposing a substitute in sixteen decimal places, to produce more minute accuracy.

His genius is, to my plain understanding, most unfathomable. On the first outbreak of the matter, he found a difficulty in obtaining true results, and applied to mathematicians for an exact rule; but now we learn he has no difficulty in furnishing an approximate arithmetical solution; and, besides, he can manage an exact solution from certain assumed principles, but cannot do it *neatly*, and says, "the thing" now wanted is a neat mathematical solution.

To my rude taste, truth in rags is a more brilliant gem than error flounced out in embroidered symbols, which are often but a flimsy covering for the defects within; yet as the matter in dispute may have acquired some consequence, I hope he will favour the readers of this journal with a rescript, both of the principles assumed, and of his approximate arithmetical and exact mathematical solution.

His logical flourish about the contents of the bulb of the thermometer not being in any definite proportion to the section of its stem, and that heterogeneous quantities cannot be compared, because the fundamental idea of proportion involves a reference to a common unit, is a piece of sophistry still to be unravelled. He might also have asserted, that there is no definite proportion between the temperature and pressure of steam, because temperature and pressure are heterogeneous properties of matter. His reasoning, however, would have been good if the bulb were of the same dimensions at all temperatures; but its dimension varies with the temperature, and the same of its contents; and was intended by the words on which he has commented is, when explained more at length, that when the divisions on the scale are equal spaces, the section of the stem must vary in different parts of its length in a definite proportion to the increase of volume of the bulb, in which case the scale will indicate true temperature.

I now further add, that when the stem is of uniform section or diameter, the spaces on the scale, instead of being equal, being marked according to the following series, will exhibit true temperature, when the air is at zero and the bulb at (n) degrees; but when the air is at any other temperature, a correction will be requisite to determine true temperature.

$$\frac{(\overline{m+1} - \overline{g+1}^3)\,a}{m+1},\quad \frac{(\overline{2m+1} - \overline{2g+1}^3)\,a}{2m+1},\quad \frac{(\overline{3m+1} - \overline{3g+1}^3)\,a}{3m+1},$$

&c., &c., to (n) degrees. The sum of which series being equal to the length of the scale from zero to (n) degrees, and the respective terms of the series being each measured and marked upwards from zero, such marks will be the degrees on the scale.

A thermometer intended to show the temperature of the air, or for any other purpose when both the bulb and stem are at the same temperature, the series will be same as the above, omitting the divisions, $m+1$, $2m+1$, $3m+1$, &c., to (n) degrees.

I shall be happy to find that the above may attract investigation, as a well-meant attempt towards establishing a true scale of temperature, subject nevertheless to an exception, which would invalidate it as a universal measure of true temperature, viz., as respects that of steam, the zero of which scale must be placed at or about 4° C., or 40° F., or strictly at the point at which water is at its maximum density.

John Curr.

7 *Upper Penton Street, March* 3, 1849.

ELECTRICAL IMPROVEMENTS.

Your notice of Mr. Staite's Patent has induced me to send you a few remarks upon the claims that gentleman has made. I am the more anxious to do so, because Mr. Staite has manifested great want of liberality in trying to prevent the use of his form of apparatus in philosophic investigation.

The great value of this patent was said to consist in the patentee having discovered a form of battery, the resulting compounds of which were of equal or greater value than those originally used. His specification is published, and, instead of this valuable addition to electric science, we find that Mr. Staite has really discovered nothing but one or two unphilosophical arrangements—the remainder are not discoveries, but appropriations. His first pretence is a perfluent battery. Now, this is almost as old as Daniell's battery. Smee and Noad mention the use of syphons or perforated partitions, by which the electrolyte might be made to pass from cell to cell. In the lectures of the latter gentleman we have nearly an exact copy of one of the drawings given in Staite's specification—the flexible syphons he expressly mentions. The alterations made in the new plan are not improvements.

The amalgam of zinc and mercury proposed to be adopted, will not be so effective as a positive metal, or as the amalgamated zinc generally used, besides being more expensive. The sole use of mercury on the zinc plate is to prevent oxidation of the zinc before contact is made, and to prevent local action. This is accomplished by the cohesive affinity existing between mercury and hydrogen, so that the latter element adheres to the former. Lead, as a positive metal, is claimed. Faraday has mentioned several times, in his "Researches," the use of this substance as a positive metal, with dilute nitric acid as the exciting fluid, but adds, that it is not a good one. Claim 12 is the most valuable invention if true. It is, however, contrary to the facts established by Faraday. He distinctly proves that when the electric current is flowing through a helix, either with or without an iron cone, no addition to the current can be discovered, or in reality exists, but that when contact is made or broken, the current is rendered more intense. Upon this principle, magnets have been long publicly known to intensify the electric current, but when applied as specified, they are useless, and effectually prevent local currents. When, however, a negative metal is introduced in a state of polarity by being in contact with the zinc plate, the hydrogen leaves the mercury and passes to the negative metal, thus seeking to establish the electrical equilibrium. Mercury, therefore, retards the oxidation of the metal, and in equal ratio, the development of electricity. This hindrance, however, is more than compensated for by the prevention of local action and the saving of zinc. But the proper proportion of mercury is, to leave just as much upon your zinc as will prevent local action, any excess is detrimental to the power of the battery. An amalgam such as Mr. Staite has patented will, I am confident, not yield only one-half as much electricity as the usual amalgamated metal, while it is three or four times as costly.

His last claim is to obtain the valuable substance after the exhaustion of the battery, of which so much boast has been made. The whole is fudge, and an attempt to monopolize what has long been public.

The precipitation of the oxide of zinc from its sulphate in the way mentioned has been long known, and the assertion that you have, as the result, the free sulphuric acid which you can again use in the generating cell, is notoriously untrue. Instead of that, you have the sulphate of ammonia, which will be more expensive to turn into simple dilute acid than the original cost of this substance. I do not know the value of the oxide of zinc; I believe, however, that it will not yield as much as will purchase the carbonate of ammonia with which to precipitate it.

He then talks of using platinized lead, to obtain any of the salts of lead. This is the capital absurdity in the specification. I know that Smee speaks of trying platinized lead as the *negative* metal in his battery; but as a *positive* metal, it would not yield an atom of electricity (if I may be allowed the material phrase) that could be used. Electricity would be produced in large quantities, but it would be in an infinite number of very active circles between each atom of platinum and lead. It would be like using a very impure piece of unamalgamated zinc. Decomposition would speedily result, yet no electricity could be obtained at the electrodes of the battery. The copper and iron battery is a very weak arrangement indeed. At least 500 cells would be required to produce a light.

Upon the other part of the specification you have said all that is necessary in reply to Mr. Dommett's inquiry. We are as unable to produce a permanent electric light now, as was Sir H. Davy.

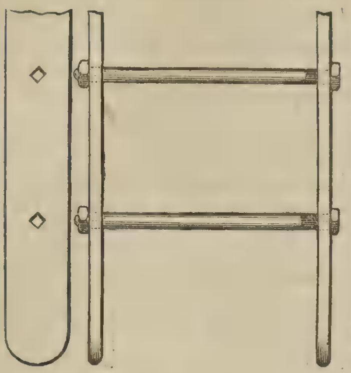
Allow me to add, in reply to Mr. Dommett, that the electric light does not burn as well in water as in any other medium. The density of the medium materially affects the passage of the current. A current capable of giving a very good light in vacuo, will not produce any in water. Besides, the water enters into combination with the red-hot charcoal, destroying it at a fearful rate. I cannot conceive a possibility of the light being permanent except in vacuo. With respect to mines, a hermetically sealed glass would be quite as safe from the ingress of explosive gas as one filled with water.

R. E. R.

Hexham, March 3, 1849.

IRON LADDERS FOR MINES.

The early decay of wooden ladders, when exposed to the humid atmosphere and rough usage of mines, may be a sufficient reason for my venturing to send you a proposition for the use of a material far better calculated for the purpose. I would recommend the universal adoption of wrought-iron for all fixed mining ladders, for the reason that it is stronger and better able to endure the wear of mining operations, than timber. The dimensions and proportions must be varied to suit peculiar circumstances. I have sketched two views of a portion of one of 10 feet in length, which is now in operation. The figures represent a front elevation of a portion of the ladder, with two steps, and a side view of one of the flat bars forming the side-pieces. The sides are 2½ inches wide, by half an inch thick; they have square holes punched into them at intervals of 6 inches, for the reception of the stepping-rods of round rod-iron, ⅝ inch diameter. The clear width between the side-pieces is 9 inches, the stepping-rods being squared to fit their holes accurately, whilst half an inch in length is left at each end for the holding-nuts.



1-8th.

A ladder of this kind is firm and durable, and is easily taken to pieces for repair or removal.

Birmingham, 21*st March*, 1849. "Iron Ladder."

THE RESISTANCE TO RAILWAY TRAINS.

It is not my intention that the last note I write in reply to your Penton Street correspondent's snarling communication of last month shall be a very lengthy one, as it is quite evident to me, and every one else, that he is one of those who delight in finding faults, while utterly incompetent to find a remedy.

What I said I adhere to; and, having conversed lately on the subject with several practical engineers, I do assert, and think most persons will agree with me, that to pick out *one* experiment on such a varying subject, and then to construct a formula in which no notice is taken either of the wind or state of the rails, and to take rough approximations of areas and axle weights, is absurd and childish. It is true, that in the article quoted it is stated, that "scarcely a breath of air was stirring;" and it is rather odd that one who made so much fuss as to the difference between the words melting and melted wax, in his lengthy letter in reply to H. R.'s simple inquiry, did not wish to "clear off the cobwebs," as he calls it, before attempting a trashy formula. I suppose the wind will blow some time or other, and hence the necessity of a proviso in the formula.

The proposal of substituting for a self-registering instrument one which it would defy any one to read off with any accuracy at an ordinary speed, is too ridiculous even for Mr. Curr, who I fancy I see sitting on one of the front buffers, looking at "Fahrenheit, or any other known scale," and working his double-entry ledger at 43 miles an hour, and 16 places of decimals; but I suppose he just threw it in to show off his wonderful proficiency in the thermometer line. It reminds me of manager Crummles, and the splendid pump and real tubs; but as I happen to know the relation between temperature and pressure perhaps as well as he does, I will not trouble him to go to 16 places of decimals to show what it is.

It is of little consequence what principles Mr. Curr may be prepared to establish, and no business of mine what space he may occupy in your journal; and as to saying, that because I stated that the subject was one of the most difficult with which engineers have to deal, he takes it as a confession that they have as yet discovered nothing—why, it is only a further illustration of his limited knowledge of the present state of things, for a glance at any of the scientific periodicals would have controverted his assertion.

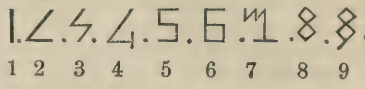
Were I writing in reply to one who was conversant with the subject, I could speak of the difficulty of getting correct results, owing to its being impracticable to attach the self-registering dynamometer in any other way than behind the tractive power; but it would be a waste of time to attempt to explain it to one who is so self-satisfied with showing off his "egotistical conceit," "insufferable dogmatism," &c. But as he has stated that there is a loss of one half in locomotion and steam navigation, should he make any drawings of variable or other expansion gearing or other improvements, I shall be happy to inspect them, and give him a candid opinion on them; and I have no doubt that the editor of this journal would insert them if of any use; but I cannot think of further trespassing on the pages of this useful journal, in a controversy with one, on a subject which it is quite obvious is altogether out of his way.

Paddington, 8*th March*, 1849. H. W.

NUMERICAL CHARACTERS.

Under the head "Notation," in Jamieson's Dictionary of Mechanical Science, is the following sentence:—"With regard to the characters of digits, by which the numbers are at this date universally expressed, they seem to be the same, with a very slight alteration, as those that were originally employed for that purpose, but their forms are not such as to indicate their origin, though some authors have discovered more ingenuity than judgment, by endeavouring to trace them to the Greek alphabet, and hence inferring, contrary to every evidence, a Grecian origin to our present system of notation." Then follow a number of Greek letters, showing their method of derivation. This article has called my attention to the general subject of numerical notation, and the consideration I have bestowed upon it has resulted in what appears to be a simpler method of derivation.

The characters of the digits in their most primitive form, as is natural to suppose, would be composed of arrangements of single dots, as, ., .., ..., &c.; or of lines, as, l, ll, lll; but as it would be desirable, for the sake of speed, to express the numbers by as few lines as possible, or by one continuous line, and such line or lines would, in their early form, be angular, I have ventured upon the following proposition,—that is to say, to show how a nearer approach to our present numerals is obtained, I shall suppose the digit, 1, to be only one stroke; the 2, an angle, or a line with two parts straight; and the 3, a zigzag line with three parts straight, as in my sketch.



It will be seen that the straight portions of the lines of these figures agree in number with the number they are intended to represent, except in the case of 4, 6, 7, 8, and 9, where some of the straight parts of the lines are divided into two parts by another line crossing them, as, for example, 8 and 9; and some are divided into two, by another line coming into contact with them, as 4, 6, and 7; and on the same principle, it will be observed, is the tail of the 9, as an addition to the 8, digit; and such parts and divisions agreeing with the numbers they are intended to represent, is my only proof that the characters of the digits were once angular.

For the tendency of angular lines to degenerate into curves, I have only to quote a few lines—nearly in connection—from the article Alphabet, in the Penny Cyclopædia:—"The form of a letter must, in the first place, depend much upon the nature of the material upon which it is written, and of the instrument employed. On hard substances, where incisions are to be made, straight lines will naturally prevail. When the letter is merely painted, or inscribed upon a very yielding material, two or more inclined lines are apt to degenerate into a simple curve." Then follow some ancient Greek letters to prove the statement, which I need not repeat. Again quoting,—"A principle of corruption not less powerful is the desire of rapidity, which is most readily obtained by connecting the different parts of a letter together, so that the whole may be produced by one movement of the instrument, or, more strictly speaking, without raising the instrument from the surface." Again it is said—"Lastly, a fanciful love of variety shows itself in all the works of man, and in none more than the arbitrary variations of letters, particularly those at the beginning and end of words. These several causes of change were more active, when nearly all writings were produced by the pens of individual writers. In modern times, the art of printing has tended strongly to create a unity of form, and will be the best protection against future change."

After thus digressing, I will return to the subject of numerical characters, and commence with those of the angular form, as given above. The 1 agrees with the digit 1 of the present day; and the 2 would agree if it had a curve at the top. The 3 would nearly agree, if it had a curve at the top. Such curve on the 2 and 3 of the present time is to be accounted for, by supposing the hand, in writing quick, to be accelerated from left to right, as the laying down of the hand, in beginning a stroke, would, if not prevented, naturally produce a curve. The 4 exactly agrees with our 4, as also would the 5 and 6, were they not angular. The resemblance of the 7 is not quite so clear; the 8, excepting its angles, agrees closely with ours; the 9 has a quadrangle too much. This want makes it both easier to write and more distinct from the 8. I may also advert to the derivation of the small Roman b from the capital B.

But, after all I have said, it may be that, in a more primitive form than that of the examples here given, the straight portions of the angular lines may all have been equal in number to the number they were intended to represent. I could add many more examples of my theory, but shall for the present leave something for the imagination of your readers.

Thornhill, Stirling, Feb. 13, 1849. J. M.

MITFORD'S CENTREING GUAGE.

The operation of centreing round and square iron for the lathe, frequently takes more time than the actual turning of the article, when once set for that purpose. I am aware of the existence of what is termed, the "universal centre punch;" but, like most other inventors, I look upon my own offspring as the best; and I now send you a sketch of the guage which I use for the same purpose. The instrument is drawn one-third size; fig. 1 is a side elevation, and fig. 2 a corresponding plan of it. A A, Is the body of the guage, forming a quadrant, with a rectangular guide upon its face; B, is a brass slide, fitted with a centreing pin or tracer.

Fig. 1.

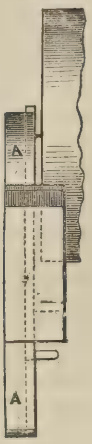
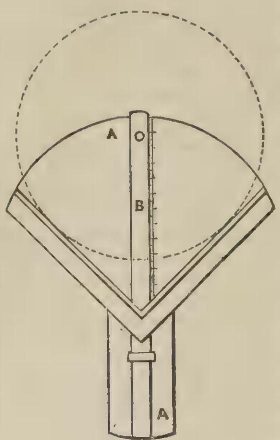


Fig. 2.



1-3d.

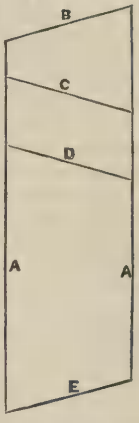
In centreing a piece of ½ inch round iron, the brass slide with its tracing point is drawn down to the ½ inch division, or near it, as it is not essentially material to set it exactly. The end of the piece to be centred is then set into the angle at the guage, and turned round against the pin on its slide. In this way, a small circle will be traced on the end, or, if the division at which the slide is set, corresponds exactly with the radius of the piece, the actual centre point will be marked. In operating upon square bars, the piece is set in the angle as before, any one side being kept flat down upon one side of the rectangular guide, drawing it along, so as to cause the point to trace a straight line. This is to be done on all four sides, when the point of junction will indicate the centre. Hexagons, octagons, or other polygons, may be treated as round. The instrument is equally applicable for centreing irregular figures.

Cheltenham, Feb. 1849. BERTRAM MITFORD.

[It is hardly necessary to remark, that this guage acts upon the principle, and is really a practical modification, of the "square for finding the centre of circles" given at page 69, *ante.*—ED. P. M. J.]

CONE-PULLEYS—TEETH OF WHEELS—LONDON STEAMERS.

If "Signarium" constructs his driving wheels at the same angle as that of the pulley, the original length of strap will answer for all the relative speeds. As an illustration, let the parallels, A A, be drawn, then draw the lines, B C, of the pulley at any angle corresponding with the required velocity, and let D and E on the wheel be laid down parallel to B and C.



As to the "teeth of wheels," I may state, that if a disc corresponding to the size of the pinion, with a line drawn from its centre to the periphery, is rolled on a circle equal to the circumference of the wheel, the end of the line being in contact with the circle, it will describe an epicycloidal curve, which is the true form of the teeth. The great circle must, in like manner, be made to roll over the lesser one, to give the curve for the pinion teeth.

I throw in another line or two to my list of jottings, to remark upon the curious and clever manner in which the London steamers are brought up to the wharf in stopping. When at a short distance from the wharf, a slight motion of the paddles brings them broad-side up, without any connection with the shore.

W. R. S.

Plymouth, February, 1849.

QUESTION IN FRAME-WORK.

In your last number a correspondent wishes to know the method generally of apportioning the strains in a trussed beam, or principal rafter of a roof. The following rule will, I think, answer all the conditions of his question:—

Let $ab =$ distance from apex of roof to junction of tie with rafter.
$ad =$ vertical height of a above b.
and $cd =$ vertical height of c above b.

Then, by rule, if $w =$ weight to be supported at a, the strain on rafter will $= \dfrac{ab \times w}{2ad} = \mathrm{S}$.

Strain on tie bar $bc = \dfrac{\mathrm{S} \times bc}{ab} = \mathrm{S}^1$.

And strain on suspension bar $ac = \dfrac{\mathrm{S}^1 \times 2dc}{bc}$.

In the particular example given by your correspondent R. S., the respective strains are as follow:—on ab 11·18 tons, on bc 10·2 tons, and on ac 4 tons.

JOS. F. STRONG.

Ipswich, February 14, 1849.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTE OF MECHANICAL ENGINEERS.

The Annual General Meeting was held at Birmingham on the 24th of January last, J. E. M'Connell, Esq. in the Chair.

After the transaction of the ordinary business of the meeting, Mr. Robert Stephenson was formally elected President for the ensuing year, and the professional business commenced by the reading of a paper by Mr. De Bergue, on a "Station Buffer." The moveable buffer-rods are of timber, furnished at their lower surfaces with two wrought-iron racks bolted to them; these racks gear into two pinions cut out of the solid of a horizontal shaft carried in bearings at each end, attached to the frame-work of the apparatus. In the centre of the shaft is a boss, slightly larger than the pinions, and upon this boss is keyed a cast-iron friction pulley, surrounded by a friction clip. Above the pinions two friction pulleys are placed, for the purpose of retaining the racks duly in gear. The pitch of the teeth is 1½ inches, breadth of racks 5 inches, and breadth of pinions 5½ inches.

Two cast-iron cheeks rest at one end on the shaft, their other ends being bolted down to the ground. These cheeks are placed one on each side of the friction pulley, the shaft being at liberty to revolve freely between them, but they act as levers to resist the revolving motion of the shaft. They are connected together by a stay bolt passing through both, one end of the friction clip being attached to it. Two smaller cheeks are also attached to the same rod, and the opposite end of the friction clip is attached by a bolt to their lower extremities. A steel spring, attached at one end to the two small cheeks, presses at the other upon the back of a curved wrought-iron lever, held at one end upon the bolt connecting the two larger cheeks, and upon this it may oscillate. An angle iron cross-beam is fastened at its two ends to the buffer-rods, and travels with them; and on the centre of this beam, just beneath the curved lever, is a small friction roller grooved for the reception of the lower surface of the curved lever.

When the buffers are driven up by the impetus of a body coming in contact with them, the racks, gearing into the pinions on the shaft, will compel the shaft and friction pulley to revolve, and the friction clip will offer a resistance to this revolution, in proportion to the pressure put upon it by the pressure of the spring. As the buffers proceed in their course, the grooved roller is carried forward horizontally in a straight line, forcing up the curved lever, which, pressing harder upon the end of the spring, continually increases the pressure on the friction clip.

We do not see what advantage this possesses over the stationary buffer at Hunt's Bank, Manchester, which is composed of four double elliptical springs, having about 6 feet of action. It is fitted with rectilinear ratchets, with catches to hold back the springs when driven up, to prevent recoil. In Mr. De Bergue's buffer, it is stated that it gives out its re-acting power to a train at once, and is not driven up so far as in the ordinary spring buffer, before it opposes much resistance.

Mr. Richmond then explained his improved "Engine Counter." This Engine Counter is not brought forward as an original invention, but as an improvement on the engine counters previously used. The main points of improvement are the simplicity and certainty of the action; for however rapidly the counter may be worked, it is impossible that the first, or units hand, can move more or less than one division of the dial for each stroke of the engine; and another improvement is the method of calculation adopted, all the hands revolving the same way. This counter is much less expensive than those previously used, and it is now being generally adopted for marine engines going transatlantic voyages; the expense of the Great Western Counter was £25 or £35, whereas the price of this instrument is only £7, and it tells up to 1,000,000. Another point of importance is the great expense in the Great Western and Great Britain steam-ships of attaching the engine counter to the main shaft, whereas, all that is required with this counter is a reciprocating action of half an inch. There is also a security against mistakes in reading off the counter, each dial keeping a check on the other. When No. 1 has reached 100, No. 2 will have marked one division; when No. 2 has reached 1000, No. 3 will have marked one division; and when No. 3 has reached 10,000, No. 4 will have marked one division, so that it is impossible that any mistake can occur in the end, as each dial continually checks the next one.

Mr. Hick brought forward his starting and disengaging apparatus for driving heavy machinery, as bleachers' mangles and calenders. This apparatus has now been some time in use, and is pretty well known. In the opinion of the meeting, it is one of the best arrangements of the kind.

INSTITUTION OF CIVIL ENGINEERS.

TUESDAY, FEBRUARY 20, 1849.

JOSHUA FIELD, ESQ., PRESIDENT, IN THE CHAIR.

"On the explosion of Fire-damp which occurred in the Eaglesbush or Eskyn Colliery, Neath, South Wales, on the 29th of March, 1848," by Mr. Joshua Richardson, M. Inst. C.E.

This paper first detailed the frequency of these occurrences in some parts of South Wales, and more particularly in this colliery, where the tender and friable nature of the coal peculiarly induced in the working, or excavation, the formation of fire-damp and explosive gas. This had been shown experimentally by Sir Humphrey Davy, when, on breaking up large coal under water, he collected a quantity of fire-damp at the surface.

It then gave a description of the colliery workings; the state of the mine before the explosion occurred; the condition in which it was found at the time of the inspection—a fortnight after the accident; the probable causes of the catastrophe, and the best known means of preventing a recurrence of such events.

The seam of coal was described as being about four feet in thickness, of a highly bituminous and friable nature, and worked by an inclined adit or entrance, with a main gallery, whence the stalls were worked on either side—horses being employed to draw out the coal in trams, which were conveyed direct to the vessels in which it was shipped for exportation to the extent of thirty thousand tons annually. The ventilation was effected by a down-cast and an up-cast shaft, between which an air course was arranged so as to extend throughout the active workings, with a chimney at the exit, through which the air should have been expedited by a furnace, which, however, had been rarely lighted; and the air course, which was one mile and five furlongs in length, was in places of unequal and inadequate areas, so that, in certain states of the external atmosphere, the air in the mine became very sluggish, and even at times oscillated to and fro instead of regularly travelling onwards in an uninterrupted current. This was so much the case, that the colliers employed fans to drive the gas from them into the proper channels. Great negligence appeared to have existed, both in the general system of working, and in the use of the Davy lamps, which were frequently used without the wire gauze guards.

The usual state of the mine could not be judged of by an inspection *after* an accident, as all the falls and incumbrances had been removed, the destroyed doors and stoppings had been well replaced, and general precautions had been adopted, which evidently had not previously existed; but there still remained evidences of want of precautionary measures. Candles and open lamps had been constantly used, although the general fiery character of the mine was notorious; and, after the explosion, two Davy lamps were found without their wire gauze guards.

The temperature in various parts of the mine was so near that of the external atmosphere, that it was evident spontaneous ventilation could not have proceeded regularly; and it was shown, that the slightest change of the density of the air, even from the sun breaking out, would have sufficed to render stagnant the whole system of ventilation; especially as the furnace, which should have accelerated the current by exhaustion, had been allowed to fall into a ruinous condition, and had seldom been used, and the velocity of the current had rarely exceeded five feet per second, which was totally inadequate to supply the requisite quantity of air for such an extent of workings.

The cause of the accident was therefore very apparent, and might be attributed to a want of a general good system of ventilation, permitting accumulations of gas and fire-damp, and the careless use of open lights, or unserviceable Davy lamps; and the consequence of this was the sudden death of twenty men, and several horses, with great injury to the mine.

The means of prevention were, evidently, a complete revision of the system of ventilation—the enlarging of the air course to uniform and adequate dimensions—the proper division of the air into several columns—the construction of proper doors and stoppings in convenient positions—strict regulations for the use of Davy lamps, or other means of lighting, and better general superintendence, by educated men, who would enforce precautionary measures.

Due credit was given to the proprietors for their anxiety to afford every means of inspection, and for adopting all suggestions calculated to prevent the recurrence of such an event; and it was stated that they had since erected one of Mr. Price Struve's ventilating apparatus, of the working of which an account was promised in a future communication.

In the discussion which ensued, the various systems of working and of ventilation, in all parts of England, were noticed; and it was shown that, in general, every means was adopted to prevent accidents; but that, up to the present time, the mines in the West were not as well managed as those in the North, or the midland district. Every day, however, introduced better measures and better men, of education, for carrying into effect the most approved systems, and that, as the mines became more extensively worked, so these accidents would and did become less frequent.

TUESDAY, FEBRUARY 27, 1849.

"On Fire-proof Buildings," by Mr. James Braidwood, Assoc. Inst. C.E. After alluding to the paper by Mr. Fairbairn, on the construction of buildings of this description, which was read during the session of 1847, the author proceeded to analyze the evidence as to the capability exhibited by cast and wrought-iron beams, for sustaining weights, where they were exposed to any extreme changes of temperature. He then demonstrated, by a collection of specimens of metal from buildings that had been destroyed by fire, that occasionally the temperature in the conflagration of large buildings rose almost to the melting point of cast-iron, and that, even in a small fire, beams and columns of cast-iron would be so affected by the heat and the jets of water upon them, that they would probably be destroyed, and sometimes cause a fearful loss of life; as in many of the so-called fire-proof warehouses of the city, a number of persons employed on the premises slept in the upper floors, and, if the lower beams gave way, the whole would be dragged down suddenly; whereas timber beams resisted fire some time, and allowed time for the inmates to escape. The firemen, also, were liable to more danger from the same circumstance; as the only chance of extinguishing fires was to send them into the buildings with the branches and water-hose; but where there was such evident danger, the men were forbidden to enter, and limited their efforts to restraining the spreading of the fire.

Another point which the author considered had not been sufficiently insisted on, was the derangement of the brickwork by the expansion of the iron beams at high temperature, and its sudden contraction on the application of cold water; and, also, from the mortar becoming completely pulverized by the excessive heat—instances of which have been known to occur.

The following were the principles on which Mr. Fairbairn proposed to construct Fire-proof Buildings:—

1. The whole of the building to be composed of incombustible materials, such as iron, stone, or brick.

2. That every opening or crevice communicating with the external atmosphere be kept closed.

3. An isolated stone or iron staircase to be attached to every story, and to be furnished with a line of water-pipes communicating with the mains in the street.

4. The different warehouses to be divided by strong partition walls, and no more openings to be made than are absolutely necessary.

5. That the iron columns, beams, and brick arches be of a strength sufficient not only to support a continuous dead pressure, but also to resist the force of impact to which they are subject.

Lastly. That in order to prevent the columns from being melted, a current of cold air be introduced into the hollow of the columns from an arched tunnel under the floors.

Mr. Braidwood argued that there could be no doubt, if the second principle could be enforced, a fire would go out of itself; but it was very doubtful if the object was not defeated by carelessness in leaving a door or window open just at the time when a fire occurred.

The fifth principle showed, that Mr. Fairbairn had not laid sufficient stress on the loss of strength to the iron consequent on an increase of temperature; and the last principle, it was thought, would not be likely to answer the purpose, as a specimen of $1\frac{1}{2}$ inch cast-iron pipe, on being heated in the centre, with both ends open, and a current of air passing through it, gave way, on one end being held in a vice, and the other pulled with slight force by the hand, after an exposure of only four minutes in the fire.

For these reasons and others, the author submitted that large buildings containing considerable quantities of combustible goods, and constructed on the usual system, were not practically fire-proof; and that the only construction which would render such buildings safe, would be groined brick arches, supported by pillars of the same material laid in cement. The author was also of opinion, that the loss by fire would be much reduced if warehouses were built of a more moderate size, and completely separated from each other by strong party walls, instead of being constructed in immense ranges, into which, when fire had once penetrated, it set at defiance all efforts to extinguish it.

In the discussion which ensued, the accuracy of Mr. Braidwood's general statements was fully accorded; and it was generally acknowledged, that the principles upon which many buildings, particularly dwellings, were constructed, were very erroneous. It was argued, that even with the ordinary materials, if attention was paid to filling-in the partitions and ceilings, as practised in France, and mentioned in Professor Hosking's book on the construction of buildings; using slate or stone for the stairs, as from its present cheapness might be done, taking care to support the steps properly, a fire would spread very slowly, and would allow ample time for the escape of the inhabitants.

Beardmore's, Fox and Barrett's, and Nasmyth's new systems of flooring, were all alluded to; as was Mr. P. Fairbairn's fire-proof dwelling-house at Leeds, of which a drawing and description was promised for the next meeting.

Chubb's, Marr's, and other fire-proof safes were advantageously mentioned, and were shown to have effectually preserved the deeds within them in the most intense conflagrations.

TUESDAY, MARCH 6, 1849.

The discussion on Mr. Braidwood's paper "On Fire-proof Buildings," was renewed, and extended to such a length as to preclude the reading of any paper.

It was urged, that the intention of Mr. Fairbairn's paper, and that of Mr. Braidwood, had been somewhat misunderstood; the former had for object the description of defects in the construction of fire-proof buildings for supporting heavy weights of machinery, &c.; and the latter, leaving untouched the question of construction, viewed the effects of fire upon metal beams in fire-proof buildings. These were widely different questions.

The consideration of what was the actual loss of strength of cast-iron, under different degrees of elevation of temperature, was of vital importance. It appeared, from the evidence of Fairbairn's and Hodgkinson's experiments, that there was very little difference of strength between iron, at a temperature below the freezing point, and when raised to nearly six hundred degrees Fahrenheit. When, however, cast-iron columns and beams were practically subjected to the draught, or current of air, of a tremendous fire, in an extensive warehouse filled with combustible goods, and at the same time receiving large quantities of water from the engines, they must fail, either by melting, or crushing.

It appeared, that all the means of arresting fires generally failed, when there was a large area on fire, and that the only effective means of prevention would be, to have smaller and detached warehouses, or separating walls within the larger storehouses; but, inasmuch as this was a very expensive mode of building, and the land where warehouses were required was very costly, it became entirely a mercantile question, whether it was better to lay out a large capital in making a building perfectly fire-proof, and providing such means as were in use in a mill at Oldham, for deluging the rooms on an alarm of fire, or pay an insurance and incur a certain amount of risk.

That the risk of fire in dwelling-houses was not very great, appeared to be admitted, by the small rate of insurance demanded—generally from eighteen pence to two shillings per cent., upon which the government charged three shillings additional for stamps—certainly the lion's share—without bearing any of the risk.

It was shown, that the system of constructing mills containing machinery, with iron beams and brick arches, was as much for the purpose of avoiding the tremulous movement imparted by wooden beams and floors, as for avoiding the risk of fire; for such were the precautions and care in the mills, that very few were destroyed by fire. It was suggested, that bricks might be made expressly of the proper form to surround the slight iron columns used in buildings, and thus completely protect them from any injury from fire.

Phillip's system of extinguishing fires, by means of carbonic acid and steam, was mentioned; and it appeared, that it was excellent for isolated houses in the country; for use in the hold of a ship, or inside any room; to arrest a fire at the commencement, without injury to the furniture, &c.; but that it could not be rendered so useful as water, in preventing the extension of fires to adjoining buildings. This interesting discussion was interrupted by the monthly ballot, when the following candidates were elected:—G. Meredith, A. H. Bampton, W. P. Struvé, T. C. Watson, W. Scamp, H. Maudslay, J. W. Leather, and I. Coode, as Members; Lieut.-Colonel J. A. Lloyd, R.E., Captain Sir E. Belcher, R.N., C. B. Lane, H. G. Robinson, T. Gibbins, G. A. Biddell, I. N. Warren, C. P. Roney, C. L. A. De Bergue, E. B. Wilson, H. Robinson, S. D. Martin, W. T. Doyne, W. Swann, H. Vignoles, W. B. Lambert, and R. A. Stickney, as Associates.

TUESDAY, MARCH 13, 1849.

"Description of the Camden Station of the London and North-Western Railway," by Mr. R. B. Dockray, M. Inst. C. E.

In the first design of the railway, in 1833, this station was intended for the sole terminus of the line, and, after much discussion, thirty acres of ground were purchased, although that quantity was considered preposterously large. A very short time demonstrated the necessity for the establishment of the Euston Station solely for passengers; and fourteen acres were there secured, and ultimately covered with buildings. The whole station at Camden was then devoted to goods and cattle; and although in the original design great care was taken to anticipate the wants of the traffic, yet such has been the rapid development of the railway system, that in the space of ten years it has proved necessary to sweep away almost every vestige of the original constructions, and entirely to remodel the station. These changes have been partly produced by the increase in the goods' traffic, which was first undertaken by the great carriers, who built large warehouses on the Company's land. The whole system has, however, been reformed, and the Company do all that business, and are responsible to the public for the due performance.

As the increase of the traffic progressed, the trains in the sidings frequently became of such length as to cause danger to the passenger trains; it therefore became necessary to alter the whole disposition; which has been so done, as now to give a length of double line of two thousand five hundred feet, for the goods waggons only, entirely clear of the main line.

Another reason for the alterations was, the demand by the public for a more rapid rate of travelling: this demanded heavier and larger engines, and necessitated wider buildings and larger turn-tables; in fact, everything required to be remodelled;—and the results of all these changes were shown in detail in the paper and the illustrating drawings.

The circular engine-house, one hundred and sixty feet diameter, to contain twenty-four engines and tender, with a central turn-table, forty-one feet in diameter, and an iron roof, was excellently described; as were also the other engine-houses, stores, warehouses, sheds, &c., with their appurtenances; and among the external works, the new wrought-iron bridge, at Chalk Farm, on Mr. R. Stephenson's box-girder principle, and the wooden lattice bridge over the Regent's Canal.

The supply of water for the locomotive engines was then treated of at some length, and exhibited some curious anomalies. The only water that could originally be used, was taken from wells at Tring and at Watford; an attempt was, however, made to obtain a supply at Camden station, first from the Regent's Canal, and then by sinking a well down one hundred and forty-five feet into the chalk, or to a total depth of three hundred feet below Trinity high-water mark. The water from the sand stratum was excluded, and although only that from the chalk was pumped up, which ought to have possessed the same qualities as the water at Tring and Watford, derived also from the chalk, yet it was found to cause the locomotive to "prime," or flush water through the cylinders, with the steam, to such an extent as to seriously impede the progress of the trains. This was shown, by analysis, to arise from the excess of carbonate of soda contained in this well water, which there was an entire absence of in the waters of the wells at Tring and at Watford.

The well, therefore, became useless for the engines, but the water was so excellent for household and other purposes, that it has been employed for the general uses of the station, and for the hotels and houses belonging to the Company.

Some idea of the extent of the station was given by the statement, that the length of single line of railway, exclusive of the main lines, exceeded twelve miles. There were one hundred and twelve sets of points, one hundred and ninety-six turnplates, and one hundred and ten cranes, varying in power from one ton and a half to twenty tons. The area of goods sheds was upwards of one hundred and thirty-five thousand superficial feet, and that of the platforms was thirty thousand feet.

The annual consumption of gas exceeded six millions of cubic feet.

The discussion that ensued, turned chiefly on the causes of the excess of alkalinity in the water at that spot, and it was suggested, that it might be owing to the rapid filtration of surface water through a crevice in the chalk upon which that well had been sunk; and as a cure for the "priming," it was suggested to try a minute quantity of sulphuric acid to neutralize the alkali. There appeared, however, to be a question whether the water from the green sand was really completely excluded.

ROYAL SCOTTISH SOCIETY OF ARTS.

JANUARY 8, 1849.

JOHN CAY, ESQ. PRESIDENT, IN THE CHAIR.

The following communications were made:—

"Description of a Portable Blowpipe," by the Rev. William Taylor, 17 Westbourne Terrace, Hyde Park, London. The blowpipe was exhibited.

The Aneroid Barometer was exhibited and described, by Alexander Bryson, Esq. Mr. Bryson stated that on trial he had found the barometer to correspond with the common barometer, within the ordinary limits, say from 28 to 31 inches, to within a tenth of an inch, so that for all ordinary purposes it might be trusted to. It has the advantage over the common barometer, in being easily transported, having no liquid in its interior. It is of a circular shape, like a watch, and is about five inches in diameter, having an index hand which points to the weight of the column of air.

"On the suggested deoxidating power of Artificial Light of great intensity, as the explanation of the decomposition of Water by white-hot Platina," by George Wilson, M.D. An experiment with the oxy-hydrogen blowpipe was shown in illustration.

JANUARY 23, 1849.

"Description and Drawing of a Bowstring Bridge-Rib," by Messrs. Fox, Henderson, & Co., London Works, Birmingham.

"Description of an Improved Window-Sash, allowing the outside of the Window to be cleaned or glazed without danger," by Mr. Charles Deans, Carpenter, Forres. A Model was shown.

This safety window effectually prevents all chance of accident, as the glass of both upper and lower division may be cleaned with perfect ease and safety by a person standing on the floor inside of the window. The principle is applicable to every form of modern window, and consists in the panes of glass being contained in a separate frame, which is to be exactly adjusted to and fitted in the sash, to which it is to be attached on one side by hinges, the other side remaining free and opening inwardly like a door. In appearance it can scarcely be distinguished from the present window, and the expense is not materially different.

"Description of the Wax-Candle Safety Mining Lamp," by Mr. John Crane, Lee Crescent, Edgbaston, near Birmingham.

[This lamp we described and illustrated at page 150, *ante.*—ED. P. M. J.]

FEBRUARY 12, 1849.

DAVID RHIND, ESQ. F.R.S.E., VICE-PRESIDENT, IN THE CHAIR.

"Description, with two Drawings, of a Method of Preventing Accidents at Coal-Pits," by Mr. William Alexander, Mining-Engineer, Summerlee Iron-Works, near Glasgow.

The breaking of the winding-rope, and continuous movement of the machinery beyond its proper place, are two circumstances rife with accident and loss of life in mineral workings. Mr. Alexander avoids the *first* by an improved catch in connection with the cage; and the *second*, in consequence of winding by friction, which becomes self-acting, in preventing the rise of the cage past a given point.

"Description of an Hydraulic Bramah Press, with Improved Safety-Valve," by Mr. Hay Dall, Brassfounder, 37 Nelson Street, Tradeston, Glasgow. A working Model was exhibited in action.

This improvement in the Bramah press consists in doing away with the heavy weight formerly hung on the safety or disengaging valves, and thus producing greater certainty of action, and a saving of expense, by preventing the liability to wear and break up, to which the present construction is exposed.

"Description of a Machine for Dressing Straw Bonnets, or other matters where hot or cold pressure is required," by Mr. George D. Howell, 1 Young Street, Edinburgh. The Machine and a Model were exhibited.

The machine and model now exhibited are intended to reduce the labour and many inconveniences in the old mode of blocking straw bonnets, which, from the pressure required on the breast, often produced complaints in the chest, and consumptions. The machine has been in use for some time, and found to answer every purpose required in the art.

The pressure which, in the old mode, was given by the breast and arm, is by this machine given by the lever worked by the foot, and counterpoised by the back weight, which instantly lifts the blocking iron when the pressure of the foot is withdrawn.

FEBRUARY 26, 1849.

JOHN CAY, ESQ. PRESIDENT, IN THE CHAIR.

"On a Method of making Flint Glass for Optical purposes," by Mr. William Cooper, Glass Manufacturer, Aberdeen.

Mr. Cooper, in his communication, states as a known fact, that "crown glass," a manufacture peculiar to this country, answers very well for optical purposes; but hitherto there has been great difficulty in obtaining suitable flint glass of a uniform density, and free from striæ, wreathes, &c.; and this may be attributed to the Excise restrictions formerly altogether preventing, by heavy penalties, the necessary trials being made to produce a suitable glass, and hence we were driven to France and Switzerland for a supply, where no obstacles exist in the way of making it.

The mixture given by Mr. Cooper was stated to produce a glass suitable for optical purposes; and the Excise restrictions being removed, and being possessed of materials and every other facility for making it equally good, it is expected that the manufacture of optical glass will be perfected in this country.

The following recipes are given by Mr. Cooper for making good optical flint glass:—

Sand, well washed, dried, and sifted,	60 lb.
Oxide of lead,	60
Purified carbonate of potash,	15
Saltpetre,	3.5
Cullet,	15 to 20

The specific gravity of this glass is 3,568, and of ordinary density. A heavier glass is obtained by altering the proportions thus:—

Sand,	60 lb.
Oxide of lead,	63
Purified carbonate of potash,	14
Saltpetre,	3.25
Cullet,	20

The specific gravity of this glass is 3.628. In both cases the cullet must be of the same kind of glass.

Before disposing of this communication, the Secretary was instructed to write to Mr. Cooper to send specimens of optical glass made after these recipes, or to communicate the names of opticians who had used the same and found it good.

"Statements regarding the American Saw-Gin, for separating the Seed from the Cotton Fibres; and as to the practicability of applying Steam-Power to the Roller-Gin: and Description and Drawings of a Steam-Power Roller-Gin," by Robert Burn, Esq. North Merchiston House, Edinburgh. Specimens of Cotton in the Husk, and a Model of the Roller-Gin were exhibited.

After describing Whitney's Saw-Gin, and assigning the alteration of climate as the cause of the failure to introduce it into the East and West Indies, Mr. Burn, in explanation of the above-mentioned model, pointed out that the application of steam-power to this, the only kind of Gin adapted for the cotton of those countries, was mainly wanting to reduce the price of their produce to that of America, and, by an increased supply, to place the cotton trade in safer foundation, and more secure against the growing competition of the United States.

In support of this hypothesis, Mr. Burn adduced the past history of the cotton trade, and the transfer of it from the East Indies to Britain by mechanical science and skill, in the application of steam-power to the spinning-wheel and power-loom, which at first was slow, but sure in its progress.

In the United States, this mechanical skill is now carried to as high a pitch, and by the invention of the Saw-Gin they are in advance of us, as no similar machine has yet been adapted to the cotton of any of the British colonies.

"Description and Drawing of a New Hydraulic Locomotive and Railway," by Mr. Daniel Erskine, plumber and gas-fitter, Clerk Street, Edinburgh. A rough model of the Locomotive and a Revolving Syphon were shown in illustration.

This locomotive is constructed on a principle altogether different from any other hitherto invented. It resembles the present locomotive only as to the frame-work, while the top resembles a stage coach. The propelling power is water, turning an overshot wheel, fitted in an air-tight case in the centre of the carriage; the water is supplied by a syphon, fixed to the locomotive, and dipping into the trough of water after-mentioned. Mr. Erskine showed experimentally that the syphon will do its work, although moving through the water at the rate of 60 miles an hour, and even at greater speed. The syphon is supplied with water from a trough of cast-iron supported over the railway, and having a longitudinal division from end to end open at the top, capable of being heated to prevent the water from freezing in winter. It is to be supplied with locks to answer the gradients of the railway. The locomotive opens and shuts the locks in travelling along the line, and the surplus water is conducted into a narrow trough between the two lines of rails, and is allowed to run waste, or used for purposes of irrigation. The further consideration of this communication was postponed until Mr. Erskine shall complete his working model.

MONTHLY NOTES.

IMPROVED BAKING OVENS.—M. Violette's late discovery of the carbonization of wood, described by us in a former page, has led to what appears to be an important improvement in baking ovens. Steam, heated to 480° Fahrenheit, is found to convert dough into a light well-baked loaf, superior to that produced in the ordinary way. The idea offers to effect a considerable improvement in the condition of the operatives employed in bakeries, for, by its assistance, a good system of ventilation will be secured. The steam is generated by a helical tube in a common furnace, and, after coming in contact with the bread, it is suffered to escape, loaded with all the impurities emitted from the bread, which are thus carried off out of the way of the workmen. M. Violette's plan will, doubtless, be found valuable for the processes of coffee-roasting, timber-seasoning, and numerous operations, where heat is necessary.

WEAVING MATCH.—Blackburn, in Lancashire, is noted for its improvements in power-weaving, and some of the best movements in modern looms have had their origin in that town. As there are always several rival contrivances working their way forward, it has occurred to the proprietors of two of the latest, that the best test of their respective merits would be, to work a series of each class of loom, side by side, the resulting quantity and quality of cloth to guide the umpire's decision. This proposition is now being carried into effect, and is causing considerable interest in the town.

ENGLISH PATENTS.

Sealed from 16*th February*, 1849, *to* 14*th March*, 1849.

Charles Thomas Pearce, Park-road, Regent's-park, Esq.,—"Improvements in apparatus for obtaining light by electric agency."—February 16th.

Charles Frederick Whitworth, Hull, gent.,—"Improvements in preventing accidents on railways."—17th.

John Bottomley, Bradford, York, manufacturer,—"Improvements in machinery for weaving."—22d.

Amedee Francois Remond, Birmingham,—"Improvements in machinery for folding envelopes, and in the manufacture of envelopes."—28th.

William Brindley, Twickenham, papier mache manufacturer,—"Improvements in the manufacture of waterproof paper."—28th.

Charles Jacob, Nine Elms, Surrey, engineer,—"Improvements in the manufacture of earthenware tubes or pipes."—28th.

Dion de Bourcicault, Quadrant, Regent-street, gentleman,—"Certain improvements in the mode or modes to be used for transmitting and distributing liquids and fluids for agricultural purposes, and for apparatus connected therewith."—28th.

Thomas Rowlandson, Liverpool, chemist,—"Improvements in the treatment of certain mineral waters to obtain products therefrom, and in obtaining certain metals from certain compounds containing those metals, and in obtaining other products by the use of certain compounds containing metals."—28th.

Charles Andre Felix Rochez, New-court, St. Swithin's-lane, merchant,—"Improvements in the manfacture of oxide of zinc, and in the making of paints and cements where oxide of zinc is used."—28th.

Pierre Isidor David, Paris,—"Improvements in bleaching cotton."—28th.

Job Cutler, Spark Brook, near Birmingham, civil engineer,—"Certain improvements in the manufacture of metal pipes or tubes."—28th.

George Fergusson Wilson, Belmont, Vauxhall, gentleman,—"Improvements in separating the more liquid from the more solid parts of fatty and oily matters, and in separating fatty and oily matters from foreign matters."—28th.

Clemence Augustus Kurtz, Wandsworth, Surrey, gentleman,—"Certain improvements in looms for weaving."—28th.

Obed Blake, Thames Plate Glass Company, Blackwall, Middlesex, manager,—"Certain improvements in the process or processes of manufacturing and finishing plate sheets or panes of glass."—28th.

Joseph Barker, Esher-street, Kennington, artist,—"An improved method of constructing umbrellas and parasols."—28th.

John Hick, Bolton-le-Moors, Lancaster, engineer, and William Hodgson Gratrix, Salford, in the same county, engineer,—"Certain improvements in steam-engines, which improvements are more particularly applicable to marine engines, and also improvements in machinery or apparatus for propelling vessels."—28th.

Benjamin Birom, Wentworth, York, gentleman,—"Improvements in miners' lamps."—28th.

Robert Pollard, Topsham, Devon, rope-maker,—"An improvement in rope-making machinery."—28th.

Henry Crosley, of the firm of Henry Crosley, Son, and Galsworthy, Emerson-street, Surrey, engineers and copper-smiths,—"Certain improved modes or methods of, and apparatus for, heating and lighting, for drying substances, and for employing air in a warm and cold state for manufacturing purposes."—28th.

Perceval Moses Parsons, Lewisham, Kent, civil engineer,—"Certain improvements in railways, railway engines and carriages, and certain of their appurtenances."—28th.

Edward Westhead, Manchester, manufacturer,—"Certain improvements in the manufacture of wadding."—March 3d.

Henry Constantine Jennings, Abbey-street, Bermondsey, practical chemist,—"Improvements in the manufacture of vehicles for mixing pigments, and also in the manufacture of white lead."—5th.

Nathan Defries, Grafton-street, Fitzroy-square, civil engineer, and George Brooks Petit, Brook-street, New-road, Middlesex, gas-fitter,—"Improvements in applying gas to heat apparatus containing fluids, and in heating and ventilating buildings, also improvements in gas-fittings and apparatus for controlling the passage of gas."—5th.

Samuel Banks, West Leigh, Lancaster, miller,—"Certain improvements in mills for grinding wheat and other grain."—5th.

William Henry Green, Basinghall-street, London, gentleman,—"Improvements in the preparation of fuel."—5th.

James Baird, Gartsherrie, Old Monkland, Lanark, Scotland, iron-master, and Alexander Whitelaw, of the same place, manager,—"Improvements in the method or process of manufacturing iron."—7th.

Andrew Shanks, Robert-street, Adelphi, Middlesex, engineer,—"An improved mode of giving form to certain metals when in a fluid or molten state."—14th.

John Smith, Hare Craig, Dundee, factor to Lord Douglas of Douglas,—"Improvements in the manufacture of flour, applicable to the making of bread, biscuits, and pastry."—14th.

Robert Ross Rowan Moore, Temple, barrister-at-law,—"Improvements in the manufacture of letters and figures to be applied to shop fronts and other surfaces."—14th.

George Fergusson Wilson, Belmont, Vauxhall, gentleman,—"Improvements in the manufacture of candles and night-lights."—14th.

James Williamson Brooke, Camden Town, gentleman,—"Improvements in lamps."—14th.

Thomas Clarke, Hackney, Middlesex, engineer, and Thomas Motley, Bristol, civil engineer,—"Certain improvements in obtaining and applying motive power, also improvements in railroads and other roads, and in supporting pressure, resisting strain, and protecting against fire."—14th.

Robert Plummer, Newcastle-upon-Tyne, manufacturer,—"Certain improvements in machinery, instruments, and processes, employed in the preparation and manufacture of flax and other fibrous substances."—14th.

William Payne, 163 New Bond-street, Middlesex, watch and pedometer maker,—"Certain improvements in clocks and watches."—14th.

Alexander Swan, Kirkaldy, Fife, manufacturer,—"Improvements in heating apparatuses, and in applying hot and warm air to manufacturing and other purposes, where the same are required."—14th.

William Gratrix, Salford, Lancaster, bleacher and dyer,—"Certain improvements in the method or process of drying and finishing woven and other fabrics, and in the machinery or apparatus for performing the same, part of which improvements is applicable to stretching woven fabrics."—14th.

Ignacio de Barros, Lisbon, Portugal, but now of Paris, gentleman,—"Improvements in machinery for making lasts for boots and shoes, butts or stocks for fire-arms, and other irregular forms."—14th.

Allen Bragg, Queen's-row, Pentonville, bath-keeper,—"Improvements in propelling by atmospheric pressure."—14th.

Francis Hay Thomson, doctor of medicine, Hope-street, Glasgow,—"An improvement or improvements in smelting copper or other ores."—14th.

Pierre Augustin Chauffourier, Regent's-quadrant, merchant,—"Certain improvements in the manufacture of watches."—14th.

Peter Armand Lecomte Fontainemoreau, South-street, Finsbury, London,—"Certain improvements in coating or covering metallic and non-metallic bodies."—(Being a communication).—14th.

IRISH PATENTS.

Sealed from 20*th January*, 1849, *to* 20*th March*, 1849.

John Mitchel, chemist, Henry Alderson, civil engineer, and Thomas Warriner, farmer, Lyons Wharf, Upper Fore-street, Lambeth, Surrey,—"Improvements in smelting copper." —February 14th.

William Clay, Clifton Lodge, Cumberland, engineer,—"Certain improvements in machinery for rolling iron or other metals, parts of which improvements are applicable to other machinery in which cylinders or rollers are used."—14th.

William Martin, St. Pierre les Calais, Republic of France, mechanist,—"Certain improvements in machinery for figuring textile fabrics, parts of which improvements are applicable to playing certain musical instruments, and to printing, and other like purposes." —21st.

SCOTCH PATENTS.

Sealed from 19*th January*, 1849, *to* 22*d March*, 1849.

William Martin, St. Pierre les Calais, Republic of France, mechanist,—"Certain improvements in machinery for figuring texile fabrics, parts of which improvements are applicable to playing certain musical instruments, and to printing and other like purposes." —January 24th.

Joseph Deeley, Newport, Monmouth, engineer and iron-founder,—"Improvements in ovens and in furnaces."—24th.

Alexander Parkes and Henry Parkes, Birmingham,—"Improvements in the manufacture of metals, and alloys of metals, and in the treatment of metallic matters with various substances."—31st.

Laurence Hill, jun., Motherwell Iron-works, Hamilton, Lanarkshire, civil engineer, in consequence of a communication from Henry Burden of Troy, United States of America, —"Improvements in the manufacture of iron, and in the machinery for producing the same."—31st.

Francis Hay Thomson, Hope-street, Glasgow, M.D.,—"An improvement in smelting copper or other ores."—February 2d.

Ewald Riepe, Finsbury-square, Middlesex, merchant, in consequence of a communication from Antoin Lohage, residing abroad, and partly by invention of his own,—"Improvements in the manufacture of soap."—5th.

David Napier, and James Murdoch Napier, York-road, Lambeth, Surrey, engineers,— "Improvements in mariners' compasses, also in barometers, and in certain other measuring instruments."—5th.

Rees Reece, London, chemist,—"Improvements in treating peat, and obtaining products therefrom."—5th.

Edmund George Pinchbeck, Fleet-street, London,—"Improvements in certain parts of steam-engines."—5th.

James Robertson, Great Howard-street, Liverpool, Lancaster, cooper,—"Improvements in the manufacture of casks and other wooden vessels, and in machinery for cutting wood for those purposes."—5th.

Fennell Allman, 18 Charles-street, St. James's-square, Westminster, consulting-engineer,—"Improvements in apparatus for the production of light from electricity."—7th.

Achille Chaudois, Paris, Republic of France, manufacturing-chemist,—"Improvements in extracting and preparing the colouring matter from orchil."—7th.

Thomas De la Rue, Bunhill Row, Middlesex, manufacturer,—"Improvements in producing ornamental surfaces to paper and other substances."—9th.

Jonah Davies and George Davies, Albion Iron Foundry, Tipton, Staffordshire, iron-founders,—"Improvements in steam-engines."—9th.

Samuel Brown, the younger, Lambeth, Surrey, engineer,—"Improved apparatus for measuring and registering the flow of liquids, and of substances in a running state, which apparatus are in part also applicable to other useful purposes."—12th.

Hugh Bell, London, Esq.,—"Certain improvements in aerial machines and machinery, in connection with the buoyant power produced by gaseous matter."—19th.

William Clay, Clifton Lodge, Cumberland, engineer,—"Certain improvements in machinery for rolling iron or other metals, parts of which improvements are applicable to other machinery in which cylinders or rollers are used."—19th.

Carey M'Lellan, Larch Mount, Londonderry,—"An improved corn-mill."—20th.

Emanuel Miller, Baltimore, Maryland, United States of America, gentleman,—"Certain improvements in dressing or cleaning grain, and in separating extraneous matters therefrom."—(Communication.)—21st.

James Baird, Gartsherrie, Old Monkland, Lanark, iron-master, and Alexander Whitelaw, Gartsherrie Iron-works, manager of said works,—"Improvements in the method or process of manufacturing iron."—21st.

Samuel Wellman Wright, Chalford, Gloucester, civil engineer,—"Certain improvements in preparing various fibrous substances for spinning, and in machinery and apparatus connected therewith."—27th.

Michael Loam, Treskerly, Gwennap, Cornwall, engineer,—"Improvements in the manufacture of fuzees."—28th.

William Edward Newton, Office for Patents, 66 Chancery-lane, Middlesex, civil engineer,—"A certain improvement or improvements in the construction of wheels."—(Being a communication from abroad.)—March 5th.

John Smith, Hare Craig, Dundee, factor to Lord Douglas of Douglas,—"Improvements in the manufacture of flour, applicable in the making of bread, biscuits, and pastry."—6th.

Robert Jobson, Hollyhall Works, Dudley, Stafford, engineer,—"Improvements in the manufacture of stoves."—5th.

William Edwards Staite, Throgmorton-street, London, civil engineer,—"Improvements in the construction of galvanic batteries, in the formation of magnets, and in the application of electricity and magnetism, for the purpose of lighting and signalizing, as also a mode or modes of employing the said galvanic batteries, or some of them, for the purpose of obtaining chemical products."—7th.

Charles Thomas Pearce, Park-road, Regent's Park, Middlesex, Esq.,—"Improvements in apparatus for obtaining light by electric agency."—7th.

Richard Lanning, Clichy-la-Garenne, Republic of France, chemist, partly in consequence of a commuuication, and partly his own,—"Improvements in the modes of obtaining or manufacturing sulphuric acid."—9th.

George Nasmyth, Great George-street, Westminster, civil engineer,—"Certain improvements in the construction of fire-proof flooring and rooffing, which improvements are also applicable to the construction of viaducts, aqueducts, and culverts."—12th.

George Fergusson Wilson, Belmont, Vauxhall, gentleman,—"Improvements in separating the more liquid parts from the more solid parts of fatty and oily matters, and in separating fatty and oily matters from foreign matters, and in the manufacture of candles and night-lights."—13th.

Thomas Henry Russell, Wednesbury, patent tube manufacturer, and John Stephen Woolrich, Birmingham, chemist,—"Improvements in coating iron and certain other metals, and alloys of metals."—13th.

Charles Robert Collins, Brunswick-street, Glasgow, paper-manufacturer,—"A certain improvement or improvements in the manufacture of paper."—14th.

John Hick, Bolton-le-Moors, Lancaster, engineer, and William Hodgson Gratrix, Salford, Lancaster, engineer,—"Certain improvements in steam-engines, which improvements are more particularly applicable to marine engines, and also improvements in machinery or apparatus for propelling vessels."—16th.

William Edward Newton, Office for Patents, 66 Chancery-lane, Middlesex, civil engineer,—"Improvements in engines, or apparatus principally designed for pumping water."—(Communication.)—19th.

William Galloway and John Galloway, Knot-mill Iron-works, Hulme, Manchester, Lancaster, engineers,—"Certain improvements in steam-engines."—21st.

Thomas Robinson, Leeds, York, flax-spinner,—"Improvements in machinery for breaking, scutching, cutting, hackling, dressing, combing, carding, drawing, roving, spinning, and doubling flax, hemp, tow, wool, silk, and other fibrous substances, and in uniting fibrous substances."—21st.

DESIGNS FOR ARTICLES OF UTILITY.

Registered from 25*th Feb.* 1849, *to* 15*th March*, 1849.

Feb. 15th,	No. 1782.	Dean, Dray, & Deane, London Bridge,—"Cinder-sifter."
16th,	1783.	George Allen, Stepney,—"Safety-catch for the handles of railway and other carriage doors."
19th,	1784.	Edward Newman Fourdrinier, Camden Town,—"Hat-suspender."
20th,	1785.	William Burgess, Blackfriars'-road,—"Gutta-percha label-holder."
—	1786.	Welsh, Margetson, and Co., Cheapside,—"Aerial Stock."
22d,	1787.	M. M. Gariel, Paris, M.D.,—"The aqueductor for surgical purposes."
23d,	1788.	George Shardlow, Nottingham,—"Body Guage."
24th,	1789.	Edouard Belmer, Peter-street, Westminster,—"Spring lever for spring hats."
—	1790.	Sabrina de Caulier, Coleman-street,—"Shirts or under garments for males and females of all ages."
—	1791.	Robert and William Wilson, Wardour-street,—"Shower-bath."
—	1792.	William Wilson, Manchester,—"Triple bath-tap."
26th,	1793.	James Badcock, Downham-road, London,—"Hook for fastening garments."
27th,	1794.	Edward Bird, Birmingham,—"Lamp for railway carriages."
—	1795.	Charles Eagle and John Egginton, Birmingham,—"Fastening for articles of dress."
March 1st,	1796.	John F. Clark, Wolverhampton,—"Remington and Clark's elastic bed-laths."
2d,	1797.	Theodore de Marillac, Manchester,—"Oil-can."
—	1798.	Henry M'Evoy, Birmingham,—"Point of a wire dress hook."
3d,	1799.	John Lee Benham, Regent-street,—"Chair with a moveable back."
5th,	1800.	Charles Wright, Sloane-square,—"Invisible revolving tip for boots and shoes."
—	1801.	Andrew Bertram, Glasgow,—"Hot-water apparatus."
6th,	1802.	Clay and Son, Nuneaton,—"Folding meat hastener and plate warmer."
7th,	1803.	David Thomson, Pimlico,—"Bucket pump."
9th,	1804.	Isabella Lambert, Manchester,—"Gaiter safeguard."
—	1805.	Enoch O. Tindall and Lorenzo Tindall, Scarborough,—"Vertical Mangle."
—	1806.	Westley Richards, Birmingham,—"Percussion cap."
10th,	1807.	William Simpson, Belgrave-road,—"Water-valve or hydrant for supplying water from pipes."
—	1808.	John Edward Smith, Lawrence-lane, Cheapside,—"Combination shirt waistcoat."
—	1809.	David Burges, Glasgow,—"Water pressure regulator."
—	1810.	Charles Cave Williams, Glass-house Yard, Goswell-street,—"Buffing and drawing apparatus for railways."
13th,	1811.	William Powell, Bristol,—"Fastening stoppers for jars, bottles, &c."
14th,	1812.	Isaac Parks, Birmingham,—"Penholder."
15th,	1813.	William Powell, Temple-gate, Bristol,—"Stopper for jars, bottles, &c."
—	1814.	Richard Easthope, Birmingham,—"Cork extractor."

TO READERS AND CORRESPONDENTS.

Volume I. of the *Practical Mechanic's Journal* is now ready, and may be had from any bookseller, in cloth, lettered, price 15s. It contains 292 pages quarto size, with twenty-six large copperplate engravings of the first style, and 215 engravings on wood. Cloth covers, lettered in gold, may be obtained separately, at 2s. each. Subscribers may have their numbers done up neatly in these covers for 3s.

BOOKS RECEIVED.—"Rudimentary Mechanics for the use of Beginners," by Charles Tomlinson. "Remarks on the Weather during the quarter ending Dec. 31, 1848," by James Glaisher, Esq., of the Royal Observatory, Greenwich.

W. R. Birmingham.—We will be obliged to him for the particulars he mentions.

R. S.—See the reply to his query by Mr. Strong. We have addressed him as desired.

G. M.—The same answer applies to this communication.

J. C., Preston, writes to ask—"How are silver goods treated after the soldering is finished, in order to free them from borax, and bring them to a fine white colour? What are the preparations through which brass work is made to pass to bring out its beautiful yellow colour, and protect it from oxidation? What will give brass work a good black, and prepare it for receiving the black lead for bronzing?"

J. W. London.—We really do not see how we can make more of his query than we have already done.

A. WALKER, Cheltenham.—It would be difficult to point out a "best work" on these subjects.—See "Buchanan on Mill-work," Rennie's edition; "Robertson Buchanan on Water Wheels;" and "Tredgold."

MESSRS. TINDALL.—We have received the tracing, for which we are obliged. It shall have a place next month.

MR. RUSSELL.—We shall have pleasure in hearing further of his model.

T. D. Lindfield.—His sketch is not sufficiently clear for our comprehension. Will he favour us with a more complete drawing?

S. S. Stamford.—His present scheme for a Rotatory Engine does not appear to possess any advantages over others of the kind; in fact, the same general plan has been tried more than once.

MESSRS. STOCK.—Next month.

MR. GAIR.—We shall be glad to inspect his model again, when the additions are completed.

L. B.—We have seen the vague statement of the baking machinery to which he refers, but know no more of it than he does. Should it turn out to be of value, it will be noticed in the *Journal*.

AN AMATEUR ENGINEER.—Write to Messrs. Easton and Amos, Engineers, The Grove, Southwark, London.

Several articles which we had written, lay over for want of room.

PUBLIC HYGIENE.

"I believe that nearly half of the accidental illnesses (that is, illness not resulting from old age) that occur among the lower classes, might be prevented by proper public management."—*Dr. Arnott.*

We cannot think that the introduction into our pages, of a topic of such vital importance to the working classes, as that of their health, can need any apology. It is a lamentable fact, that many thousands of persons in these islands are annually poisoned by matters taken into the body along with the air they breathe, and that a vast amount of ill health and unhappiness is suffered by the whole surviving community. It has been proved, on the best evidence, that a large portion of these evils are remediable, and the legislature has lately taken the matter in hand. But we are quite convinced that the Government, though the main-spring of improvement, can of itself do little in the work of effectually removing these fearful evils. The people themselves must put their shoulders to the wheel, and assist, to the best of their power, in carrying out the details of any sanatory measures. The misfortune however is, that the very persons who would be most benefited by changing the present state of things are the most apathetic, and the least disposed to avert disease, and its long train of attendant ills, by taking precautionary steps. How is this? We think it mainly arises from ignorance of the facts of the case. They regard things as they are, as evils undoubtedly; but they regard them as inevitable evils, and hence they cut themselves off from all motives and all desire to remedy them. In the hope of doing something in the way of dissipating this ignorance, and of inducing such of our readers as possess any influence over their poor neighbours to exert that influence for their good, we have drawn up the present paper. The main facts have been taken from the evidence of eminent physiologists and medical men, given before a Parliamentary Committee for inquiring into the state of large towns and populous districts, and may therefore be considered as of the first authority.

The five grand requisites of a healthy existence are—1. a due supply of good air; 2. a suitable degree of temperature; 3. a sufficient quantity of nourishing food; 4. exercise of body and mind; and 5. personal cleanliness. It is to the first of these requisites that we would now confine ourselves.

Air is just as necessary to life as food, for without a due supply of this want, no food, however excellent and abundant as to quality and quantity can sustain health and strength. The atmospheric air provided for us by nature is a compound of two gases, of which one (oxygen) is consumed in the process of respiration; the other, being unsuited for the regeneration of the blood, is rejected. If we were to place a man in a room perfectly air-tight, and firmly close all the doors and windows upon him, he will at first breathe with great ease; after a while his respiration will become more difficult; at last it will cease altogether, and the man will die, unless a fresh supply of air is given him. A case of this kind, where many persons lost their lives occurred in the Black Hole of Calcutta, of which every one has heard, and the rationale of it is not difficult to perceive. All the life-sustaining part of the atmosphere having been abstracted from it by repeated inhalation, nothing remains to continue the process; it stops, just as a fire goes out, unless it is kept supplied with fuel, and the man dies of suffocation. Upon the same principle, if you put a lighted candle under a bell-glass, and place something at the mouth to prevent the air entering, the candle will burn dimmer and dimmer, until it fairly goes out. It has consumed all the oxygen about it; and flame, no more than life, cannot subsist without that gas.

But respiration does not only take away oxygen from the atmosphere, it also prepares and throws out upon it a quantity of carbonic acid—an acid which, under the form of a gas, is particularly deleterious to the bodily functions; hence there is another reason why air, which has been breathed, should be removed as soon as possible; its feeding quality has not merely been destroyed, but the whole has become contaminated.

In the human frame, a considerable part of the bulk is occupied with apparatus intended solely for the purpose of ventilating the blood; that is, of exposing it to the action of pure atmospheric air. This part is the chest, the machinery of which is kept incessantly at work. From the moment an individual enters the world until the moment he leaves it. Each individual requires, in the course of 24 hours, a supply of 600 cubic feet of pure air to maintain the healthy composition of his blood. This being so, it is very easy to understand, that if 600 cubic feet of impure air are supplied to him instead, and that not for one day only or occasionally, but constantly and habitually, the chance, or rather the certainty is, that he must die before his time. In thickly-inhabited districts, the consumption of air is enormously great. It has been calculated that the mere action of the lungs of the inhabitants of Liverpool, daily, renders unfit for respiration a stratum of air sufficient to cover the whole town to a depth of three feet. To shut up a number of men in a room, nearly closed against the admission of fresh air, is in effect to render useless the breathing apparatus provided by nature, and yet we see this frequently done in the most reckless manner. How often do we see individuals confine themselves for many hours together in small rooms, without once admitting a draught of fresh air! How often do we see persons, even in the better ranks of society, immure themselves in low narrow bed-rooms, in which they spend more than a third part of their time, and where, during the greater part of that time, they are breathing vitiated air! How is it possible such persons can enjoy a healthy existence? No wonder, indeed, that physicians should state it as their firm conviction, that the immediate and chief cause of many of the diseases which impair the health of the people inhabiting towns, and brings a considerable proportion prematurely to the grave, is the poison of BAD AIR.

Let us then consider how the air in such places becomes impure, and unfit for its grand purpose of supporting the life of man. Three causes are chiefly at work—1. the malaria which it receives from the decomposition of animal and vegetable matters in and around his dwelling; 2. the impurities given out by the body; and 3. the contamination it undergoes where a multitude of persons are inhaling it in close neighbourhoods, as previously explained.

Wherever human beings are congregated together, there will always be a mass of animal and vegetable refuse; and the quantity being, of course, in proportion to the number of persons, must always be greatest in large cities. It is, therefore, of the first importance to remove this refuse before putrefaction takes place, and consequently before the poisonous matter is matured and diffused. This can only be done effectually by a proper system of drainage and sewerage, by which the rejected remnants and accumulating filth are rapidly and completely carried away. All precautions against fevers and epidemic complaints, without resorting to these primary and fundamental means of prevention, will be in vain. The highly injurious nature of one of the gases emitted from cess-pools and receptacles of that description, has been proved, over and over again, by direct experiment. Sulphuretted hydrogen, the principal gas, is a most deadly poison. A rabbit, with its body placed in a bag of it, and its head left free to breathe atmospheric air, died in ten minutes. Nine quarts injected into the intestines of a horse, killed it in one minute. Even when largely diluted with common air, it retains in a great degree its noxious qualities; a dog was killed by being made to breathe a mixture of one part of this gas with 800 parts of atmospheric air, and a mixture of only one part with 1500 of ordinary air is speedily fatal to small birds.

It would be a very inadequate view (says Dr. Southwood Smith) of the pernicious agency of the poison generated in filthy and neglected districts, to restrict it to the disease (fever) most obviously produced by it. Its *indirect action* is highly obnoxious, though the evil is not so manifest, it is a matter of constant observation, that even when not present in sufficient intensity to produce fever by disturbing the function of some organ or some set of organs, and thereby weakening the general system, this poison acts as a powerfully predisposing cause of some of the most common and fatal maladies to which the human body is subject. For example, the deaths occasioned in this country by diseases of the digestive organs, by inflammation of the air-passages and lungs, and by consumption, form by far the largest proportion of the annual mortality. Now no one who lives long in or near a malarian district, is ever for a single hour free from some disease of the digestive organs. But disordered states of the digestive organs, not only constitute in themselves highly painful and even fatal maladies, but they lay the foundations of several other mortal diseases. By a disordered state of the digestive organs, for example, the body is so much enfeebled that it is wholly incapable of resisting the frequent and sudden changes of temperature to which the climate is subject; the consequence is, that the person thus enfeebled, perishes by inflammation, set up in some vital organ, and more especially in the air-passages and lungs, or by consumption, the consequence of such inflammation; so that, to the total number of deaths that take place annually from fever in its different forms, must be added those caused by the indirect operation of the same poison that produces fever.

He afterwards goes on to say, that it is not the body alone which suffers, by living amidst wretchedness and filth; the mind also becomes weakened. The quiet unresisting way in which the labouring class, habituated to dwell in such places, give way to the wretchedness of their lot, when attacked by disease, is a melancholy proof that they have lost the intelligence and spirit proper to the race of man. Their dulness and apathy indicate an equal degree of mental and physical paralysis. Physical wretchedness here does its worst on the human sufferer, for it destroys his mind. Again he says, the effluvium generated in close dirty districts, even when not bringing on positive disease, acts as a sedative poison in depressing both body and mind. It induces physical listlessness, rendering the people incapable of any great exertion, and this feeling of depression is one of their chief inducements to the use of stimulants. "I quite believe that the inducement to take the most pernicious amount of stimulating liquids and opium, often arises from a sensation of lassitude and languor, the direct result of the debilitating causes that are incessantly acting upon them, and that renders them so incapable of physical and mental exertion."

To show how general is the ill effect of bad air upon the organs of the body, we may adduce the evidence of another medical gentleman, who had directed his attention to the structure of the ear, and the cause of deafness. In deaf persons, the membrane of the middle ear, as it is called, becomes thicker. It is a semi-transparent membrane of extreme sensitiveness and delicacy. After a dissection of several hundred ears, the anatomist in question came to the conclusion, that this membrane was injuriously affected by contact with foul air, and that the deafness might, in many instances, be ascribed to this cause.

From what has been stated, we cannot any longer be surprised at the fact of the mortality of persons resident in towns, being so much greater than those living in the country; narrow confined alleys, air-tight courts, small, densely-crowded houses, cellar dormitories,—these are the places with which all towns abound, where fevers and other epidemics are always busy to a greater or less extent, and whence they spread, as from radiating centres, into healthier parts. It must be kept in mind, that the influence of these seats of pestilence is by no means confined to those who reside within their immediate limits. Disease extends itself to the whole town, poisoning the atmosphere which all classes breathe, and hence all are interested in effecting an abatement of the evils with which such places are afflicted. There is one part of Leeds so thickly inhabited that the people are packed together at the ratio of 193,500 on the geographical mile; and there is a part of London where the population is at the ratio of 243,000 to a geographical square mile. But a part of Liverpool presents the maximum density of English cities. There the inhabitants are at the extraordinary rate of 657,936 to the same area, nearly 2¾ denser than the densest part of London. Whilst the annual mortality in the country districts of England is about 1 in 55, and that throughout England and Wales (town and country) is 1 in 46, the deaths in the metropolis are 1 in 37½, and in Liverpool, 1 in 28¾. In the country districts, out of every 1000 deaths, 202 are of persons above 70; the average number of septuagenarians, in 1000, throughout England and Wales, is 141, whilst in the towns it is only 90, in the metropolis it is 111, and in Liverpool 54. Out of every 1000 children born in London, 408 die under 5 years of age; in Liverpool 528; that is to say, 53 out of every 100. The average age of death at Kendal is about 36, at Bath 31, in four metropolitan unions 25, in Leeds 21, in Liverpool 17.

These figures show, in a striking light, the superior chance of life of persons living in situations where they can breathe good air. An American physician (Dr. Emerson of Philadelphia) bears important testimony upon this point. It is common, says he, to attribute the greater mortality known to take place under ordinary circumstances in large towns among the poorer classes, chiefly to meagre or unwholesome food, and immoderate indulgence in strong liquors. But in this country, where, for a part of the year, we are subjected to a degree of heat, little if at all below that of the tropics, the influence of both these causes in the production of disease is insignificant, when compared to that of breathing air that has been previously respired, and which, moreover, is commonly charged with animal and vegetable effluvia. That the same diet and habits of life in the country or small towns would not be attended with a degree of sickness and mortality corresponding to that found in the crowded portions of large towns, is, we think, beyond a doubt.

The complaints to which the inhabitants of towns are chiefly exposed, appear to be scrofula, fever, and consumption; and it is quite worth our while to learn the way in which these disastrous complaints are generated, and the ravages they commit.

SCROFULOUS AFFECTIONS abound to an enormous extent amongst the poorer classes—such is the testimony of medical men—and they are mainly attributable to the continued breathing of vitiated air. Sore eyes, abscesses near the joints, ringworm, and leprosy, are some of the various forms which scrofula assumes. Both on the continent and at home they are found to prevail in the most confined and worst-ventilated districts. If a change has taken place in such a district by the pulling down and rebuilding on a better plan of the houses, it has been always found that a considerable improvement resulted in the sanatory condition of the people. Professor Alison of Edinburgh says, positively, that of the early great mortality in large towns, a very large proportion is caused by scrofulous disease; and the Queen's physician, Sir James Clark, says there can be no doubt that the habitual respiration of the air of ill-ventilated gloomy alleys in large towns, is a powerful means of augmenting the hereditary disposition to scrofula, and even of inducing the disease where there is no hereditary disposition.

FEVER of every kind essentially depends on a vitiated state of the blood, arising from the introduction of some, usually animal, poison into the circulating current.

The exhalations arising from decomposing animal and vegetable matter, such as the contents of ashpits and cesspools, favour, in the highest degree, the extension of (if they do not of themselves generate, as many eminent medical men think) the disease of fever.

The mortality of all towns is very much increased by the vicious construction of the dwellings in respect to ventilation, and the supply of receptacles for refuse and excrementitious matter; the absence of drains, the deficient sewerage, and the overcrowding of the population, leading to gross neglect of personal cleanliness. These causes operate partly to induce the specific disease of fever, and partly to deteriorate the general health of the inhabitants, in such a way as to make them more liable to the attacks of nearly all diseases, but more particularly of the specific disease alluded to, and also of those organs which first bear the brunt of the poison, *i. e.* the organs of respiration.

The period of existence during which fevers are prevalent is from 20 to 40, the period of maturity, and of this period the earliest part of it is much the most subject. It was found that the average number of patients in the London fever-hospital (1825-28), for four years, was 610 per annum; and of these, 390 were between the ages of 15 and 30, whilst the remaining 220 were made up of patients belonging to periods of life above and below this.

An experience of ten years preceding January, 1834, and derived from nearly 6,000 cases, gave data for calculating, that out of 100,000 patients attacked with fever,

Between the ages of 15 and 26, there would die 11,494
" 25 " 36 " 17,071
" 35 " 46 " 21,960
" 45 " 56 " 30,493
" 55 " 66 " 40,708
" 65 " upwards, " 44,643

The risk of life thus appears to be twice as great at the age of 31 as it is at 11; nearly twice as great at 41 as it is at 21; and nearly five times as great at 61 as it is at 11. The rate of mortality in fever progressively and rapidly increases as life advances, yet the number of persons who actually perish by this disease at the adult age, and in the meridian of life, is far greater than at any other period of existence, on account of the much greater number of persons who are attacked at those epochs.

It is a singular fact with regard to epidemics, that a certain type prevails for a number of years, and that this type sometimes gradually, at other times suddenly, disappears, and gives place to another, so different as to constitute a new disease, requiring new remedies, frequently the very opposite of those employed before. This new type in its turn gives place to a third, and so on for a long series of years. These changes, notwithstanding their apparent capriciousness, depend no doubt upon fixed and determinate causes, but those causes have not been ascertained.

Any deterioration in the physical condition of the body, not only renders it more liable to be attacked by this disease, but renders the disease more severe and fatal.

As to the insidious disease of Consumption, the registrar-general puts down the appalling number of 60,000 as its victims every year in England and Wales. Of this number, Dr. Gray thinks that about 36,000 are cases of true pulmonary consumption, and he estimates the possible annual saving of adult life at 5,000. In London, the deaths from consumption are 13½ per cent. of the total annual mortality, and 1 in 246 of the population. In Liverpool, it is nearly 18 per cent. of the deaths, and 1 in 156 of the population. The proportion of deaths of females from consumption is,—for England and Wales, 1 in 431; for the metropolis, 1 in 464; for Birmingham, 1 in 404; in Manchester, 1 in 392; and in Liverpool, 1 in 298. Dr. Gray attributes a large proportion of the deaths from consumption, amongst the labouring classes, to the deficient ventilation of the places where they work; and he gives many details, the result of personal examination, which show the poisonous condition of very many workshops in the metropolis. Next to defective ventilation in destroying human life is to be ranked the inhalation of dust, metallic particles, and irritating fumes. A fruitful source of disease is the abuse of spirituous liquors.

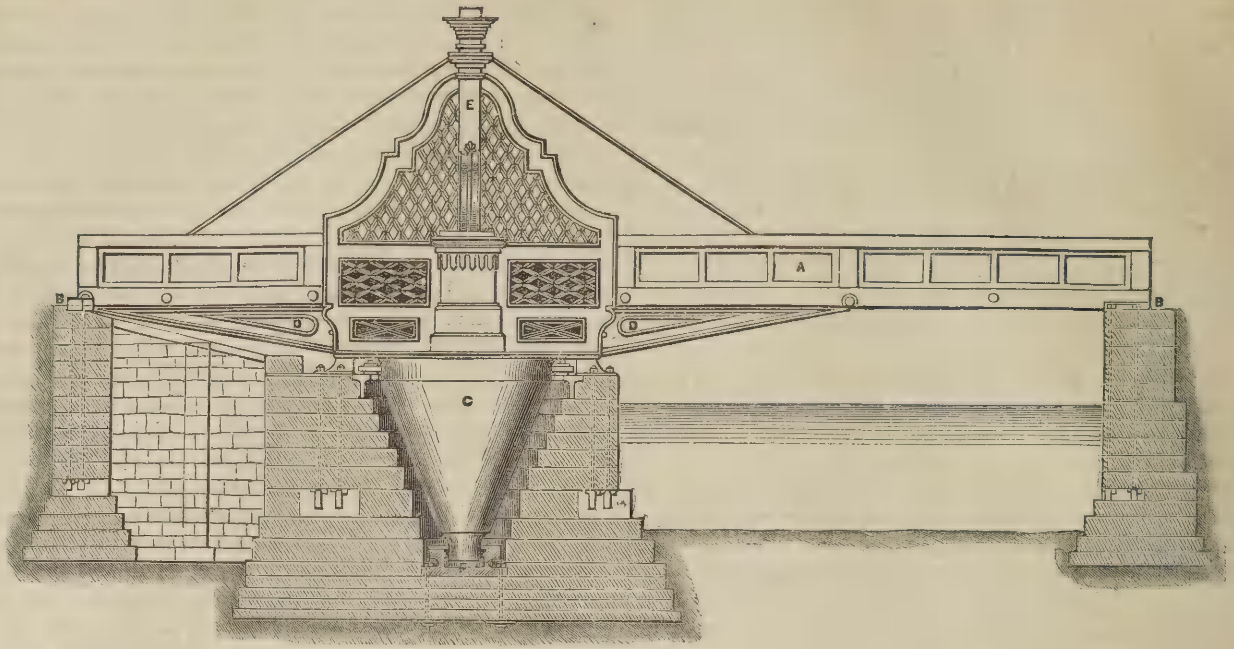
The most important part of our subject remains behind, and yet we have little space left for its discussion. What are the means of mitigating the evils arising from the inhalation of foul air? Prevention being better than cure, we must clearly do our utmost to remove the vitiating causes, and where that is impossible, we must obtain frequent supplies of air from a purer source. The first object will be attained by the employment of scavengers to remove from the surface the bulkiest refuse, and by the construction of drains and sewers on scientific principles, the thorough and systematic working of both being carried on and enforced under efficient superintendence. The drainage of towns is at present very defective. In some places the drains are open to the air, and allow pestiferous exhalations to rise into the atmosphere. Covered drains are frequently made with an insufficient fall, or of a shape that permits the heavier part of the floating refuse to settle and accumulate. Hence the current becomes clogged, is soon stopped, and the drain then becomes utterly useless, until the obstructions are removed. The sewers from private houses into the main drains are very often in a defective state, and it is highly important that those who have the superintendence of drains should have the power to enter such houses under proper regulations, in order to examine the sewers. A whole neighbourhood may otherwise be contaminated by the obstinacy of one man. Secondly, ventilation must be employed to supply the interior of apartments with air in a fit state for respiration. This is a subject as yet confessedly but little understood, and very much neglected. A fine field is here open for mechanical ingenuity, and a large amount of good might be conferred on the public by practical men taking the subject into consideration. This much seems certain, that there ought to be an opening at or near the top of every room, in order to permit the escape of bad air. Being warmer and lighter than pure air, it ascends, and can only be dislodged by an expedient of this kind. Sir James Clark, in his work on the "Sanative Influence of Climate," speaks very highly of a contrivance invented by Dr. Arnott, for ventilating rooms by means of a valved opening into the chimney near the ceiling. The valve is so nicely adjusted and balanced that it admits a free current from the upper part of the room, the region of the most impure air into the chimney, and yet prevents all return of smoke. Much (says Sir James) as Dr. Arnott has done by his scientific inventions—the Hydrostatic Bed, the Self-regulating Stove, the Ventilating Air-pump, &c.—the Chimney Ventilator, as a means of preserving health, may be regarded as the most important of the whole; and simple as it appears, it is unquestionably one of the most valuable gifts ever contributed by science to the preservation of health. The contrivance consists of a square iron tube, three to six inches in diameter, and so long that the outer orifice should be flush with the wall of the room, the inner one entering the chimney. These tubes are usually from four to six inches long. At the orifice next the room there is either a plate of perforated zinc, or a piece of fine wire-work, from the upper and back part of which hangs a piece of ordinary or oiled silk, which acts as a valve.

Mr. Toynbee, the senior surgeon to a large metropolitan dispensary, has introduced a method of ventilating apartments, which has answered very well. The ventilator consists of a plate of zinc very finely perforated with 220 holes to an inch, for the admission of external air through the windows. It varies from four to twelve inches square, according to the size and construction of the room. It is generally introduced in the uppermost portion of the window, and in the corner pane farthest from the fire-place. The fine orifices prevent the air coming in with a rush, which would occasion discomfort, and they tend to diffuse the air equally and gently throughout the room.

The want of a direct and thorough perception of the fatal results of using vitiated air, has undoubtedly kept back many remedial improvements, which, it is to be hoped, are now dawning upon us. Our enemy is insidious—unseen in its deadly progress—hence it has unhappily escaped in a great measure the scrutiny of practicians, who find scope enough in working out plans for counteracting the effects of more tangible evils.

As we began, so we shall conclude our article, by quoting the words of Dr. Arnott, whose scientific attainments, great exertions, and benevolent intentions, give him a right of audience whenever the question of public hygiene is brought forward:—"Suitable laws, and a fit administration of them, may go far to annihilate influences which now weaken constitutions, generate epidemics, and doom many of the labouring classes to hospitals and workhouses, with the consequences to all around them of lowering the morality and the general tone of mind. Thus would a labouring population, among whom there is now much depression, suffering, and disease, be changed into a more healthy, hardy, and happy people, likely to prosper in their undertakings, and to exhibit civilization in improving forms."

Fig. 1.



16 in. = 1 ft.

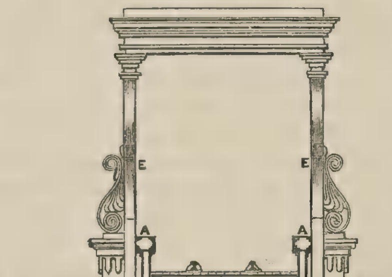
DODDS' HYDROSTATIC SWIVEL-BRIDGE.

Many are the complaints against the ordinary bridges, which are necessarily involved in the collisions between roads or railways and inland navigation. They are costly, difficult to keep in order, and troublesome to work, in so much that they may be fairly classed amongst the necessary evils of engineering. The amount of attendance which the lift or swivel-bridge, with the present actuating mechanism, requires for its mere elevation and depression, usually amounts to two, and often four men. In some instances, one man only is employed on this duty, but it is invariably at the expense of more time than can be well afforded for making the requisite movements.

Our annexed engravings represent various views of a new swivel-bridge, in which it is proposed to obviate many of the objections to which we have alluded, more especially that of the slow movement and expensive attendance. It was designed by Mr. John Dodds of St. Vincent Street, for erection at the crossing of the Stirlingshire Midland Junction Railway over the Forth and Clyde Canal, at Falkirk, but has not yet been carried out, although the masonry was contracted for in August 1847. The principle is applicable as well to lock-gates, and swivel-bridges over lock-chambers, and similar situations, enabling a single attendant to manage and work both sets of gates and the bridge with one hydrostatic pump.

Fig. 1 is a side elevation of the bridge, with a section of the canal, masonry, and a portion of the external machinery. Fig. 2 is a corresponding transverse section; and fig. 3 is a general plan of the bridge and actuating pumps on a smaller scale. The two main beams of the bridge are composed of hollow rectangular panelled tubes, A A, of wrought-iron, stretching across the waterway from B to B, at which points they are supported on cast-iron plates on the top of the masonry. These tubular girders are stayed transversely by wrought-iron tension-rods and a series of diagonal timber-frames two feet asunder, and are further supported from the centre cast-iron pivot, C, by the four cast-iron box-beams, D D, which act as struts, and convey the strain from the ends of the road-way to the top of the pivot.

Fig. 2.



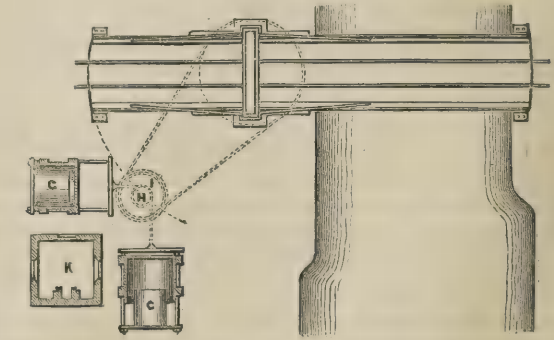
1-16th. in. = 1 ft.

The open ornamental cast-iron frames, E, rest on each side of the upper circular plate of the pivot, and are attached together at the top by a capital, and carry at their apex the saddle for the two diagonal tension-rods bolted to the girders, which they thus stiffen to a great extent.

The pivot, C, is in the form of an inverted truncated cone, cylindrical at its upper end, where it is guided by a set of stationary anti-friction pulleys. The bottom of the cone enters a small chamber, F, by a water-tight stuffing-box. This chamber is in connection with a hydrostatic ram, whereby water may be pumped in, beneath the termination of the cone, upon which its pressure will act, to elevate the whole bridge just so much as to clear its bearings, when it is to be swivelled round.

In fig. 2, the pivot is cylindrical, being so made in order to bring the centre of gravity as low as possible; and the water is pumped in beneath it as before, a stuffing-box being formed by a brass ring made adjustable to the pivot by wedges.

Fig. 3.



1-4th in. = 10 ft.

In the smaller view, fig. 3, G G, are two hydrostatic rams, the cylinders of which are placed horizontally, and at right angles with each other. These rams project out at the open ends of their cylinders, and carry cross-heads, fitted with side-rods, which pass along each side of the cylinder, and are bolted at their opposite ends to cross-tails. These cross-tails have central eyes, by which they are linked to chains passing round the small pulley, H, on the same shaft, with a larger one, I, carrying an endless chain, passed round a groove in the upper portion of the pivot of the bridge. A small lodge is represented in the plan at K, in which the bridge-keeper can stand when working the pumps of the pressure-cylinders.

Index plates are proposed to be placed over each branch of the pipe leading from the reservoir to the hydrostatic cylinders, so as to point out the existing state of the bridge at any time; thus, the words "Bridge up" will appear, when the bridge is elevated from its supports, prior to being swivelled round. When this is indicated, the stop-cock will shut off the action of the pump from the chamber beneath the pivot of the bridge, and the whole force may then be directed to turn it on its centre by the endless chain, and the bridge is turned on or off the canal as need requires.

If the bridge is over the canal, and a vessel comes up, the pump is brought into action, and, when the pivot is elevated, the cock turns to index "Bridge up;" and the index hand, over the four-way-cock, attached to the cylinders, is turned to "Bridge east;" and further working of the pump carries round the bridge, so as to leave the navigation clear. In the reverse movement, the index is altered to "Bridge west," when the same pump will effect the return. Various mechanical arrangements may be adopted for communicating the movement of the hydrostatic rams to the first chain-driving pulley. The frame-work surmounting the bridge-pivot presents a remarkably good appearance, as ornamented in the way we have shown. This portion of the details may, however, be treated in various ways, as the arrangement admits either of a plain timber triangle, or the most elaborately finished pillars.

THE BAROMETER AND ITS SCIENTIFIC APPLICATIONS.

Although the air of which our atmosphere consists, is invisible, yet it possesses several properties by which its material existence is clearly manifested. We may feel its resistance if we strike our hand through it; we see it in the shape of wind, originating motion in heavy bodies, and it is easy to prove that it has weight. This leads us to the barometer, the instrument by which that weight is shown and measured.

The theory of the barometer is very simple. Take a long glass tube, closed at the top but open at the bottom, and, after extracting the air from it, plunge the open end into a basin of mercury. The fluid metal will be seen to rise in the tube to a height of about thirty inches; the external air, pressing upon the mercury in the basin, drives the metal in a direction where no opposition is made to it, viz., up the tube from which the air has been withdrawn. But of course the pressure is limited by the weight of a column of air, equal in diameter to the interior of the tube, and extending from the basin to the top of the atmosphere; and, consequently, when the mercury has formed a column equal in weight to such a column of air, it will not rise higher. But as the weight of the atmosphere is, from various causes, continually changing, so the mercury in the tube will not long remain stationary; it will rise or fall as the pressure becomes greater or less.

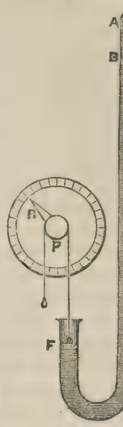
The notion that the air has weight, first occurred to Galileo. He was asked, by some persons at Florence, to explain the reason why water refused, in spite of all their efforts to bring it to the surface of the ground, to rise higher than about 32 feet, in a pump which they had made for a deep well. His first answer was, that nature abhorred a vacuum, a dogma he had derived from the Aristotelian philosophy; but afterwards directing his attention to the subject, he was led to the conclusion that air is possessed of weight, and that a column of air is no heavier than a column of water 32 feet high. His pupil, Torricelli, pursued the inquiry, and, in 1643, constructed the first barometer, by filling a glass tube, closed at one end, with mercury, and then placing the open end in a small cistern of the same metal. The mercury sank in the tube until it formed a column 30 inches in height. This metal being 13.6 times more dense than water, a column of the height specified, will be equal to one of 32 feet of water, and sufficient to counterpoise the weight of a column of the atmosphere, which, at the level of the ocean, presses with the weight of 15 pounds on every square inch.

Pascal, in 1645, verified this conclusion, by taking a barometer up the Puy de Dome, a mountain in Auvergne. He found that the column of mercury gradually fell as he mounted higher, because the weight of the superincumbent air became gradually less.

The barometer remains in principle precisely the same as it was in Torricelli's time; several attempts, however, have been made to improve its details, and it has been framed in a variety of shapes, such as the syphon, the wheel, and the portable barometers, and, latterly, as we showed last month, the "aneroid," has been again brought forward. Where delicacy is desired, the syphon is generally used. It must still be considered an imperfect instrument. In obtaining perfect sensibility and accuracy, several difficulties are encountered. 1. The tube must be entirely freed from moisture before the mercury is put into it, because, if there is any humidity, it is converted into vapour, which rises above the metal, and keeps it lower than it would otherwise be. 2. The mercury of commerce is mixed with extraneous matters which diminish its density, and render it less fluid. 3. In narrow tubes, the mercury does not rise so high as it ought, by reason of its tendency to adhere to the sides. Even in tubes with a bore of a quarter of an inch, there is a depression of 1-20th of an inch. 4. A change in the temperature has the effect of dilating the mercury, and causing it to rise higher than the mere pressure of the atmosphere would do. It becomes necessary, therefore, to apply corrections to all barometrical observations, when accuracy is a principal object.

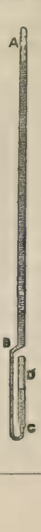
The common barometer consists of a glass tube 33 inches long, with a bore of about one-third of an inch. The top is hermetically sealed, whilst the lower end bends round into a little trough, which is full of mercury, exposed to the action of the atmosphere. This trough is frequently made of or covered with leather, through which the air acts with freedom, whilst the mercury is securely retained in its place. Alongside the tube is affixed a scale to show the variations of the height of the column, and they are still more apparent when the scale is fitted with a nonius or vernier, which indicates variations as minute as the 100th of an inch. The structure of the barometer, with a dial-plate, is shown in the annexed cut, fig 1.. The space, A B, is a vacuum; the tube is filled from B to F with mercury. Upon the surface of the mercury, in the smaller branch of the tube, is a float, F, from which a thread is conducted over a pulley, P; and to the end of the thread a weight is attached, with the view of causing the thread to act on the pulley by way of friction. As the mercury rises or sinks in the tube, the float partakes of a corresponding motion, and the pointer, R, fixed to the pulley, is likewise moved along the dial. The barometer is very seldom lower than 28 inches, or higher than 31. As a guide to the understanding of the variations of the mercurial column, certain rules have been drawn up, which are more deserving of regard than the lettering of the ordinary scale or dial. 1. The rising of the mercury presages, in general, fine weather, and its depression foul weather. 2. In hot weather, a fall indicates thunder. 3. In winter, a rise precedes frost; and in frosty weather, if the mercury falls three or four-tenths of an inch, a thaw will ensue; but, in a continued frost, if the mercury rises, there will be snow. 4. If foul weather comes quickly after a fall, there is likely to be little of it; and if fair weather makes its appearance early after a rise, much is not to be looked for. 6. In fair weather, when the mercury continues to fall for two or three days before the rain comes, so as to get very low, much wet and high wind may be expected. 7. Changeable weather is denoted by frequent changes in the height of the mercury. 8. When the top of the column is convex, it shows that the mercury is rising; when concave, that it is falling. 9. In order to derive the full benefit of barometrical indications, a thermometer and hygrometer should be observed at the same time.

Fig 1.



The simplest and most convenient portable barometer is that invented by Gay Lussac. It is a syphon tube (see fig. 2), consisting of three parts, of which the parts marked A B, C D, are of equal bore, connected by the fine capillary part, B C. Both ends of the tube are closed; but in the shorter limb, there is a hole placed in one side a little above the mercury, so as to admit the pressure of the air, but too small to permit the metal to escape, even when inverted. This instrument may be fitted into a brass frame, or even into a walking-stick.

Fig. 2.



A more complicated, but more perfect portable instrument, is one in which, by means of a screw operating upon the leather-bottom of the cistern, the mercury can be pressed upwards until it fills the whole cavity of the tube, and will no longer shake about in it on being moved. A contrivance is added, by which the mercury can be let down at pleasure to the proper level. These portable barometers are frequently used to measure the heights of objects above the sea. Having taken the height of the mercury at the foot of the elevation to be measured, and again on the summit, the following rules are sufficiently accurate for ordinary purposes:—As the sum of the heights of the mercury at the two places is to their difference, so is 52,000 to the height to be measured in feet. If the altitude should be greater than 5,000 feet, the second term of the series should be taken, which is done by striking off three figures, and cubing the half of this number. The figures thus obtained must be added for a nearer approximation.

We will now glance at the use of the barometer in meteorology, and at the atmospherical phenomena it discloses. The height of the enclosed mercury is not the same throughout the day: it rises and falls with more or less regularity in the course of twenty-four hours, but its oscillations have less regularity the farther we recede from the equator. In our latitude, in particular, the diurnal variation is disturbed by accidental causes which do not occur at the equator. Nevertheless, the diurnal variation is sensibly uniform in all climates. Commencing our observations at noon, the barometer is seen to fall until between three and five o'clock; then it rises until between nine and eleven o'clock. At that time it begins to sink once more, until about four in the morning, from which hour it rises until ten. The mean of these critical periods between the equator and St. Petersburgh has been thus calculated:—

Afternoon minimum,	4 h. 5 m.
— maximum,	10 h. 11 m.
Morning minimum,	3 h. 45 m.
— maximum,	9 h. 37 m.

In winter, the maximum and minimum approach nearer to noon, taking place earlier in the afternoon, and later in the morning.

The range of diurnal oscillations is dependent upon the latitude being less in proportion to the distance from the equator. To obtain the mean diurnal variation, we subtract the mean of the two minima from that of the two maxima. The elevation above the sea has a great influence on the range of the diurnal variation; and, from observations made in Switzerland, it would appear, therefore, to grow less the higher we mount; and it is not improbable, that at a certain height there is no variation at all. The hours of maxima and minima are not the same on the mountains and in the plains. Thus, the afternoon minimum at Zurich was between three and four; whilst on the Rigi, between four and five. At Zurich, the morning maximum was at eight; on the Rigi, about noon. These facts should always be considered in taking the measurement of heights.

All the variations that take place in a stationary barometer, must be attributed to changes in the atmospheric pressure. Kaemtz, a German meteorologist of the first eminence, concluded, from a great number of observations, that all these variations are owing to changes of temperature displacing upper strata of air; for in general, when the barometer falls, the thermometer rises, and *vice versa*. In the first case, the spot where the barometer is stationed is warmer than the neighbourhood, and the contrary takes place when the barometer rises.

The time of the mean diurnal barometrical height is, in general, between noon and one o'clock. With regard to the barometrical height at different seasons, it has been found, that in the tropics the height was less in proportion as the sun was near the zenith. For places north of the equator, the pressure gradually diminishes from January to June, and gradually increases from June to January. It is at the equinoxes that we usually see the barometer presenting its mean height. The connection between the temperature and the height of the barometer is also then perceptible.

As to the *irregular* oscillations of the barometer, they are more considerable the further we retire from the equator. We obtain the mean annual oscillation by taking the difference between the least and the greatest height of the mercurial column in each month, and dividing the sum of these differences by 12. When we compare the differences for a great number of places, we recognize the influence of longitude. Thus, in the same parallel of latitude, the oscillations are greater on the east coast of America than on the west coast of Europe, and they diminish the farther we advance into the interior of Europe. Lines which pass through all the points where the mean barometrical oscillations are the same, are termed *Isobarometrics*. Kaemtz concludes, from an examination of them, that they have a relation to the differences of temperature, which are greater for the same distance in point of latitude, the farther we recede from the equator.

The immense influence of the winds upon the height of the barometer had often been noticed, but it was not until 1771, that Lambert showed the true method of testing it, namely, by taking the mean of all the barometrical heights observed every time a given wind blew uninterruptedly for a length of time. At London, the annual minimum takes place when the south wind blows; the maximum, when the wind is N. 17° E. At Paris, the greatest height in winter is under the influence of the north wind; the lowest, under the influence of the south wind. The annual maximum takes place when the N. 24° E. wind blows; the minimum, when the S. 3° W. wind blows. At Berlin, the annual maximum takes place when the N. 58° E. wind blows; the minimum, when the S. 12° W. wind blows. The mean barometrical height nearly coincides with the direction E. and W.

Winds are well known to have great influence upon the wet or dry condition of the weather; and we must bear in mind, that, strictly speaking, the barometer does not indicate wet or fair by its variations, but only that the direction of the wind has altered. Since, however, such a change generally brings about a change of weather, the barometer has gained the credit of being a weather-glass, and hence it is frequently accused of inaccuracy when no change follows a rise or fall, whereas, it is the wind that has altered, without producing such a change.

If the barometer sinks rapidly, and then as rapidly rises to descend again immediately, it is the sure presage of a storm, especially in winter, when the temperature is high. When sudden and extensive variations of this kind take place, it shows that the climacteric condition of a part of the earth is undergoing great change.

About Christmas, 1821, the barometer sank very low throughout the whole of Europe. At Paris, and in Western Europe, the temperature, during January and February, was higher than the mean temperature by many degrees; whilst, in the United States of America, the winter was very severe, and snow covered the plains of Kordofan in Persia. The succeeding summer was hot and dry at Paris; in India, on the contrary, violent tempests blew from the sea, accompanied by much moisture; and at Bombay, there fell nearly thirty inches of rain more than the mean quantity. Again, the winter of 1833-34, which was mild throughout Europe, was extremely severe in the United States and in Persia; the following summer was remarkably dry in Europe, but the Nile rose considerably higher than usual, and much rain fell in China and Hindostan. Similar differences are not unfrequently experienced on the two slopes of the Alps, and in the north and south of France. The early months of 1838 were very cold in England, Germany, Russia, and the north of France, whilst, in the south of the latter country, there was spring weather. It is singular that, at the same period, in Italy, south of the Appennines, the spring was early; and in Lombardy, the severity of the winter continued long.

The following table explains itself:—

Places.	Mean Annual Height of Barometer.	Annual Range of Barometer.
London,	29·89	1·99
Undercliff, Isle of Wight,	29·80	1·68
Torquay,	29·88	1·96
Kendal, Westmoreland,		2.06
Rome,		1·22
Naples,		1·15
Malta,	29·89	1·27
Constantinople,	29·78	1·02
Madeira,	30·0	1·06
Port Jackson, N. S. Wales,	29·84	

The present paper will form no inapt sequel to our chapter on the "Aneroid" of last month, although, in the strictest sense, it ought to have preceded the latter dissertation. We may here introduce an emendation, which the paper in question requires—namely, at page 5, col. 1, sixth line below the table, *for* 0·0015 + (temp. 32°), *read* 0·0015 × (T. — 32°), where T. denotes the temperature.

OUTLINE OF ASTRONOMY.

No. VI.—The Stars.—(*Concluding Article.*)

The stars differ from the planets, in that they preserve their relative distances from each other, and that their disks, viewed by the most powerful telescopes, are nothing but luminous points, the diameters whereof are inappreciable. If the diameter of the nearest star to us were only a second, it would be so large that it could not be contained in the space which separates the earth from the sun. The star which is apparently the largest is Sirius, and it is probably the one nearest us. Although the earth, in its annual movement, is at one time nearer it, by 210 millions of miles, than when at the opposite part of the orbit, yet not the slightest increase of size can be observed.

The parallax of the stars, or the angle under which we should see from their centre the diameter of the earth, is insensible, and does not reach two seconds, even for the stars which, from their superior brilliancy, seem to be nearer than the others. Two careful observations of a star in the ecliptic, made at intervals of six months, when there was a difference of 210 millions of miles on the position of the observer, made not the slightest alteration in the position of the star. If the parallax of the highest stars were only four seconds, they would still be at least a hundred thousand times more distant than the sun, since that parallax would represent the angle under which the radius of our orbit (210 millions of miles) would be seen from the star. Now, an angle of four seconds is not the fifty-thousandth part of the radius: 210 millions of miles, therefore, are not the fifty-thousandth part of the distance dividing us from the nearest star.

Stars are classed by astronomers in the order of their brilliance and apparent size. The principal stars of a constellation are designated by the letters of the Greek alphabet, the first letters being given to the brightest. Those which cast a very vivid light, are termed stars of the first magnitude; and there are only fifteen of these. The next brightest are termed stars of the second magnitude; and so on through the fifteen magnitudes in which they have been hitherto marshalled. The naked eye only makes us acquainted with the first six magnitudes, that is, about 1500; but those revealed to us by the telescope are very numerous. Herschel calculated, that in a portion of the heavens, eight degrees in length by three broad, there were 50,000 stars visible through his telescope. If the rest of the heavenly vault were as thickly studded, 75 millions of stars would be seen. But, since the stars multiply in proportion to the excellence of our instruments, we may well suppose that the whole of space is filled with them; and if that is illimitable (and, as far as human faculties are concerned, there is no doubt that it is), then are the stars innumerable.

The epithet *fixed*, applied to the stars to distinguish them from the planets, is not rigorously accurate, because many of them have a palpable proper motion. We have been able to estimate the displacement of Sirius, Aldebaran, the Harp star, and others. Arcturus, in the constellation Boötes, moves at the rate of 300 millions of miles per annum; and yet it is only after a century of observation, that we have succeeded in detecting his motion towards the south. Other stars turn round a common centre. Herschel found that a great number of stars were gradually changing their relative positions; and that, in fifty double stars (*i. e.* stars which at first seem to be one, but which are resolved by the telescope into two or more) there was a change, either in the distance of the two stars with reference to each other, or in the angle formed by the line which passes through their centre in the direction of their daily motion. The star *α* (Gemini) is double, and the orbits in which the two stars move about a common centre are nearly circular, and at a right angle with the visual ray, the time of their apparent revolution being 342 years. Of the two stars composing Gamma (Leonis), the least turns round the greatest in an elliptical orbit, and accomplishes its retrograde revolution in 1200 years. One star of the beautiful double star ε (Boötes) has a pale red light, the other has a blue tint; and they have the appearance of a planet and its satellite. The double star in Hercules is composed of a large blue star, and a small ash-coloured star. The latter turns round the other, almost in the plane of an observer on the earth, and in April, 1803, something like an occultation took place. These stars, therefore, form separate systems, revolving about a common centre of gravity, for none of their motions are explainable by refraction, nutation, aberration, or annual parallax.

Several stars have periodical variations in the intensity of their light. They remain some months, or hours, invisible, and then they reappear with a bright lustre. In the Swan there are three stars of this description. One of them sometimes disappears, and afterwards becomes of the third and fifth magnitudes, the period of its variations being 596 days 21 hours. Algol, in the head of Medusa, is usually of the second magnitude, but sometimes it is only of the fifth. History makes mention of several stars which have appeared, and then entirely vanished. Some stars, described by the ancients as remarkable stars, are no more to be seen; and others are now shining, as to which they are silent. The most celebrated of all the new stars is that which suddenly appeared in 1572, in the constellation Cassiopeia. In a short time it surpassed the brilliancy of the most beautiful stars, and even of Jupiter himself. Its light then grew dim, and it disappeared, sixteen months after its discovery, without having changed its place. Its colour underwent variations likewise: at first, it was of a brilliant white; then of a reddish yellow; and lastly, of a lead hue.

The *Milky Way* is that luminous band which passes round the visible heavens, cutting the ecliptic near the two solstices. The tail of the Scorpion is placed in it. At that point it divides into two—one branch passing to the north-east, towards the Boro of the Sagittary, the Eagle, and the Arrow; the other, going northwards, passes the foot and east shoulder of Ophineus, and falls into the other division near the tail of the Swan. Democritus conjectured that the colour of this band might be produced by a multitude of stars too minute to be separately distinguished; and our times have verified the accuracy of the conjecture.

We may observe, in other parts of the sky, little stationary patches of light-coloured matter, which have been termed *nebulæ*, from their resemblances to faint clouds. The majority of them, when brought under the telescope, are seen, like the Milky Way, to be composed of stars closely compacted together; but others resist the power of the strongest magnifiers to resolve them. The most remarkable of all the nebulæ, is that placed under the belt of Orion. It was first observed by Huyghens, in 1656. Looked at through glasses of moderate power, it appears to consist of small masses, or nebulous flakes, seemingly adhering, towards their edges, to a crowd of little stars, and especially to one large star surrounded by a nebulous atmosphere, remarkable for its extent, and the singularity of its shape. There can be little doubt, that were our telescopes sufficiently strong, we should find that all the nebulæ were nothing but densely-crowded clusters of stars.

The *Zodiacal Light* is a white appearance in the sky, which is most plainly to be seen in March, after sunset, or just before his rising, in September. It takes the form of a pyramid, in the direction of the solar equator. It is much better seen near the line, than in our climes. The cause of this phenomenon is quite unknown; but it seems to be pretty generally believed, that it has nothing in common with the Milky Way, or the nebulæ.

We have previously spoken of the precession of the equinoxes, that is to say, of that annual change, to the extent of 50″, which is perceptible in the latitude of the stars. There remains for us to say something as to the aberration and nutation of the stars, and to explain, in a few words, the causes occasioning them. *Aberration* is a slight apparent motion in the stars, caused, according to Bradley's theory, by the motion of the earth, combined with the progressive motion of the light from the stars. The result is, that the fixed stars seem to describe every year a little circle, or an ellipse, about their true place. Bradley having carefully observed, at the commencement of December, 1725, the distance from the zenith of a star in the Dragon, found that, on the 20th of the same month, it had advanced towards the south. Still advancing in the same direction, it had reached a point, on the 4th March, 1726, twenty seconds distant from that where it had been observed three months previously. Towards the middle of April, it began to go up again to the north; and at the beginning of June, it was at the same distance from the zenith where it had been six months before. Its declination then changed a second in three days, which led to the conclusion, that it continued to advance to the north. In effect, the star was 20 seconds further north in September than in June: it immediately began to return to the south; and in the December following, it was observed to be at the same distance from the zenith as in the preceding year, making allowance for the precession of the equinoxes. In commencing his observations again in 1726, Bradley saw that each star appeared stationary in its greatest removal northwards or southwards, in the season when it crosses the zenith, at 6 o'clock in the morning or evening; that all advanced towards the south when they crossed the zenith in the morning, and towards the north when they crossed it in an evening. When he had observed the return of these stars to the same places where they had appeared at first, Bradley thought the constant annual cause the same for all the stars, of which the greatest effect of the north to the south was nothing, for those situate in the ecliptic (an effect contrary to that of parallax), and of which the greatest result was 40 seconds. He soon perceived that this difference of 40 seconds was precisely the distance travelled over by the earth in 16 minutes of time; and, remembering that light takes the same length of time to traverse the diameter of the earth's orbit, he hit upon the happy idea of adding the motion of light to that of the earth, according to the laws of the decomposition of forces, and that hypothesis perfectly agreed with all the observations.

Nutation is a slight apparent motion observed in the stars. It is produced, as we have before explained, by a motion of the earth, by virtue of which, the stars appear to approach and retreat from the equator. Astronomers calculate this motion with care, in order to construct tables of the nutation and aberration of the principal stars, which are necessary to be taken into account in all observations.

The Constellations.

The steadiness with which the stars retain the same relative position, has induced astronomers to refer to them, as to so many fixed points, the motions of the other celestial bodies. But, with a view to this, it was requisite that they should be classified, in order to recognize them easily, and hence arose their arrangement into different groups, termed constellations. It was necessary, also, to have their position accurately marked upon the celestial sphere; and this end was accomplished thus:—A great circle, called the circle of declination, is supposed to be drawn through the two poles, and through the centre of some star, cutting the equator at right angles. The arc of this circle, comprised between the equator and the centre of the star, measures the declination, which is northern or southern, according to the pole to which it is nearest. All the stars situate in the same parallel having the same declination, another expedient must be adopted to indicate their position with precision. An arc of the equator, comprised between the circle of declination and the spring equinox, is taken. This arc, reckoned from the equinox in the direction of the apparent motion of the sun, that is, from west to east, is that which is named right ascension; and thus the position of the stars is determined by their right ascension and their declination.

The Greeks only reckoned fifty constellations, comprising 1022 stellar bodies, but we class the stars under a hundred constellations. It will not be expected that we should find space for lists of the constellations, and describe the stars composing them. We must refer such of our readers, who feel curiosity on this head, to a little work entitled "The Hand-book for the Stars, containing rules for finding all the stars of the first and second magnitudes," by H. W. Jeans.

Eclipses.

Eclipses take place when the moon is in the ecliptic. If her orbit were always in the ecliptic, there would be eclipses at all conjunctions and oppositions, that is, at all new and full moons. But the moon's orbit is inclined 5° 9′ to the ecliptic, and only cuts it at the two points called nodes. Thus, eclipses only happen at those times when the moon is near these nodes, and she is so near the ecliptic that the earth can conceal the sun from her; in other words, throw her into shade. She must not be more than 12° from her nodes: the eclipses of the sun can only happen within 17° on each side of either node. Since the moon's nodes move in a direction contrary to her proper motion, this circumstance, coupled with the earth's motion, produces continual variations in the occurrence of the eclipses.

In general, the duration of an eclipse depends upon the distance of the sun or moon with reference to the earth. The longer the earth is engaged in the cone of shadow cast by the moon, the longer will be the eclipse; and the same with reference to the cone of shadow projected by the earth in the eclipses of the moon. Her eclipses are of more frequent occurrence than those of the sun, and it is easy to perceive the reason of this. When the moon is eclipsed she is deprived of her light, and the eclipse is seen by all the hemisphere turned to the moon. On the contrary, if it is the sun that is eclipsed, he loses none of his light, the moon merely intercepting the sun's rays. Now, she being much less than the earth, her shadow is only a cloud, which merely covers a part of the illuminated hemisphere. The moon, therefore, produces an effect similar to clouds, which momentarily deprive us of the sight of the sun, whilst we see objects in the distance, mountains, &c., still enjoying the sunlight.

Eclipses can be calculated with so much precision, either backwards or forwards, that we can, by means of them, verify the chronology of such of the ancients as observed them. The oldest of which a record has been kept, is one that was observed in China, 2155 years before our era, and which has been found by modern calculations to be accurately reported. It may be conceived that an eclipse will appear total or annular at one place, and only partial at another, and that the size and form of eclipses must vary according to the situation of the observer. Astronomers have been accustomed to trace in advance on a chart, showing the path which the shadow of the moon takes across the earth, and they thus determine with precision all the places whence the phenomenon assumes different aspects.

Parallax and the Measurement of Angles.

All astronomical calculations are founded on the measurement of angles, and on a knowledge of the approximate relation between the divisions of the circumference to the radius of a circle. We divide the circumference into 360 equal parts, termed degrees. Now, if we take a circle of metal and thus divide it, and then divide the radius of the same circle into parts of the same size, we shall see that a degree is about the 58th part of the radius. This is important to remember, because it helps to give us a certain means of calculating the distance of the planets.

With a circle thus divided, we measure degrees and arcs in the heavens. On a circle, 7 or 8 feet in diameter, these divisions are made to the 360th part of a degree, so as to measure minutes, seconds, and even fractions of seconds. To learn the distance of a planet, it is enough to know what apparent alteration of position there is on looking at it from different parts of the earth; because the more near an object is to us, the more it changes its position relatively to the object behind it, when we change our own station. This apparent alteration of place, when speaking of the stars, is termed *parallax*. To ascertain the distance of the planets by way of parallax, the most usual method is for two observers, stationed far apart, to measure at the same moment the height of a given star in the meridian. A comparison will easily explain the method. Suppose a house built upon the slope of a hill, the garden descending on terraces to the bottom of the valley; and in the garden a column surmounted by a globe, the height whereof is such that it is on a level with the windows of the ground floor. Now, looking out of one of these windows, that is, horizontally, we shall see the globe answer to some object on the opposite side of the valley; but if we ascend to another floor, we shall find, on looking out, that the globe answers to quite another point of the opposite hill, and that such other point is lower down the slope. The point to which the globe answered, when the spectator beheld it horizontally, was its *true* place with reference to the lower windows, which, in our supposition, represented the centre of the earth. The place whereto the same globe answered when he looked from the higher windows, was the *apparent* place, and the position of the spectator will there represent one on the surface of the earth. Now, suppose the globe to represent the moon, and the hill behind, the starry vault, we know the distance of our planet from the moon. It is clear that the visual ray drawn from the ground-floor to the globe, the distance from that floor to the one above, and the visual ray from the upper floor to the globe, form three lines, which are the three sides of a rectangular triangle; because the distance which separates the two stages is perpendicular to the ray from the lower one. One of the first propositions of geometry teaches us, that when a triangle is rectangular, the sum of the two acuter angles is just equal to a right angle, or 90°. If then the angle made by the visual ray from the upper window with the vertical line, measures, for instance, 88°, that number being deducted from 90°, we shall have 2° for the angle at the globe, and this is the measure of the parallax.

Now, this is the very method by which we ascertain the distance of the moon from the earth. It is a fact, that in supposing the centre of our globe, that of the moon, and some star, to be in the same straight line, an observer, stationed in the southern part of the earth, will see the moon above the star, whilst another, looking from the north, but under the same meridian, will see the moon below the star. Let us then imagine a right line drawn from the station of one observer, to that of the other. This line will be the base of a triangle, of which the two sides will be lines drawn from each observer to the moon, and since two of the angles and the base of this triangle are known, we can readily ascertain the two remaining sides and angle.

The orbit of the moon being elliptical, the parallax is of course different at different points in her path, and this variation in the parallax, which always bears a direct proportion to the apparent diameter of a planet, affords data for ascertaining, with rigorous exactness, the eccentricity of the moon's orbit.

All the calculations of the distance of the planets from the sun, and of the satellites from the planets, are confirmed by Kepler's third law, which may be expressed in these terms: The cube roots of the squares of the times of the revolutions of any two planets, are to each other as the distance of either from the sun is to the distance of the other. The time of Jupiter's revolution is $11\frac{1}{2}$ times longer than that of the earth's revolution. Squaring this number we obtain about 125, of which the cube root is 5, and this gives the number of times by which Jupiter is farther from the sun than the earth. This is but a rough calculation; but when we work from the exact data, an accurate result is obtained.

We have previously stated, that the parallax of the fixed stars is inappreciable, that two observations made from opposite points of the terrestrial orbit, at a distance of 210 millions of miles from each other, detect no change in the place of the star observed, nor any alteration in its size. If the parallax of the nearest star were a degree, the earth would be seen from it under that angle; and since a degree is the 58th part of the radius, the star would be distant 58 times 210 millions of miles. But the parallax is not even so much as 2″, and 2″ are not the hundred-thousandth part of the radius, so that the nearest star is removed from us at least 100,000 times 210 millions of miles. At this enormous distance, a hair placed before an observer's eye would conceal our entire system.

Measurement of Diameters.

The apparent diameter of a planet is the angle under which it is seen. For example, the sun at the beginning of July is seen under an angle of 31′ 30″, and Venus, when she is nearest us, under an angle of one minute only. This diameter increases as the distance diminishes. Thus, the sun being about a thirtieth part nearer the northern hemisphere in winter than in summer, his apparent diameter is greater to us in the former season. The apparent diameter of a body is measured by the time it takes to pass before a very fine thread placed in the telescope. The precise moment is observed when its edge reaches the thread, and the moment when it quits it. The time elapsing between these two moments expressed in degrees, at the rate of 15 to the hour, gives the apparent diameter. Thus, in observing the sun, if two minutes of time elapse during his passage before the thread, it is a proof that he is 30 minutes in diameter; because the sun, traversing in 24 hours the 360° of the sphere, passes over 15 degrees in one hour, 1 degree in four minutes, and half a degree (or 30′) in two minutes.

The diameter of the sun being known as well as the parallax, his volume is easily calculated. For example, the radius of the earth is seen from the sun under an angle of 8″73, and that of the sun from the earth, of 16′ or 960″. We are then assured, that at the point whence the radius of the sun appears to be 960″, that of the earth appears to be 8″75; these radii being respectively in the relation of these two numbers, we have the following proportion: 8″75 : 960″ :: the terrestrial radius 1 to the sun's radius. The result will show that the solar radius is almost 110 times greater than the earth's.

The volumes of two spheres are to each other as the cubes of their radii; the cube of 110 is 1,331,000; therefore, the sun is 1300 thousand times greater than the earth.

The radius of the moon has been found to subtend an angle of 15′ 7″. The calculations of the parallax demonstrate that the terrestrial radius is seen from the moon, under an angle of 57′6; the radii of these two spheres are then very nearly in the ratio of 11 to 3. It follows that the radius of the moon is only $\frac{3}{11}$ths of that of the earth, its volume the 49th part, and its diameter 2,343 miles.

The diameters of the planets being very small, cannot be measured like the sun's and moon's by the duration of their passage. A small instrument called a micrometer is employed, which is a network of very fine wires, placed parallel to each other, one of the wires being moveable by means of a screw. The screw's motion serves to render the motion of the wire more palpable and measureable.

As to the stars, their diameter is inappreciable; viewed through the best telescopes, they pass with the rapidity of a flash of lightning before the threads of the micrometer. If the diameter of the most beautiful star, the one probably nearest to us, were a second, then, since we know that a second is nearly the 200 thousandth part of the radius, and that such star is at least 200 thousand times farther off than the sun, its real diameter would be equal to the distance which separates us from that luminary, that is, a hundred times his diameter, and consequently, its volume would be a million times greater. But since, we repeat, the stars have neither diameter nor appreciable parallax, their size and distance are alike absolutely unknown to us; but a consideration of the infinite variety of nature leads us to conclude, that there is in the heavens a progressive increase of magnitude, as amongst organized beings on the earth there is a progressive decrease in both directions, infinitely extended beyond the capacity of our imperfect organs and feeble intelligence to measure or comprehend.*

OLDFIELD'S DOMESTIC MANGLE.

This is an efficient substitute for the old horizontal-weighted chest mangle, so inconvenient to work, and so sluggish in its movements. It is adapted as well for general mangling purposes, as for wringing and pressing clothing. Fig. 1 is a front elevation of the machine; fig. 2 is a corresponding side view. The framing consists of two cast-iron cheeks, flanged at the bottom for attachment to a table or stand. These cheeks have a wide vertical groove in the centre, having V edges, fitting grooves formed on the brass bearings of the three wooden rollers. The requisite pressure is given to the rollers by a stout semi-elliptical steel spring, similar to that of a coach; the ends of this spring abut upon the upper surface of a long horizontal bar, which passes across the machine, and sides in the grooves of the cheeks, resting upon the bearing of the upper-roller. The tension upon this spring is capable of adjustment, by a screw passing through the centre of the top-stay, which binds together the upper ends of the cheeks, and pressing upon the centre of the convex side of the spring.

Fig. 1.

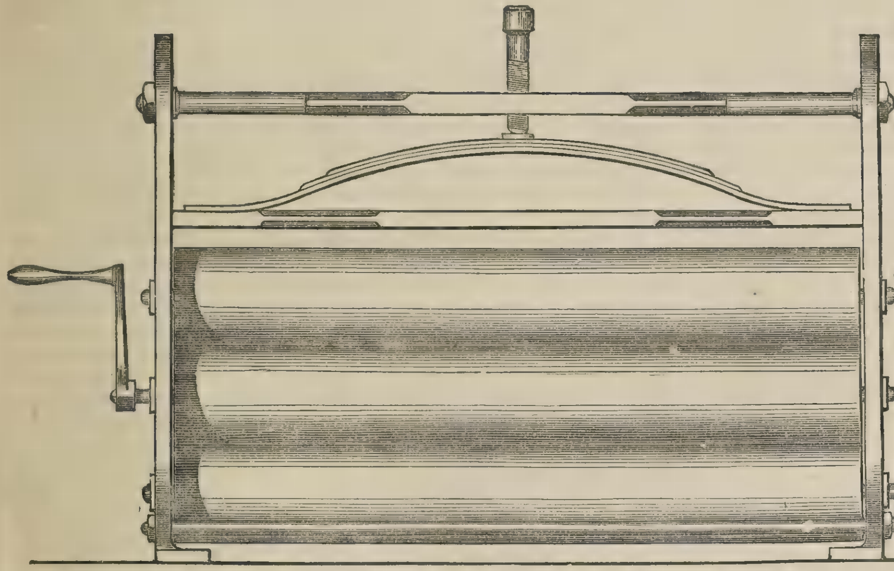
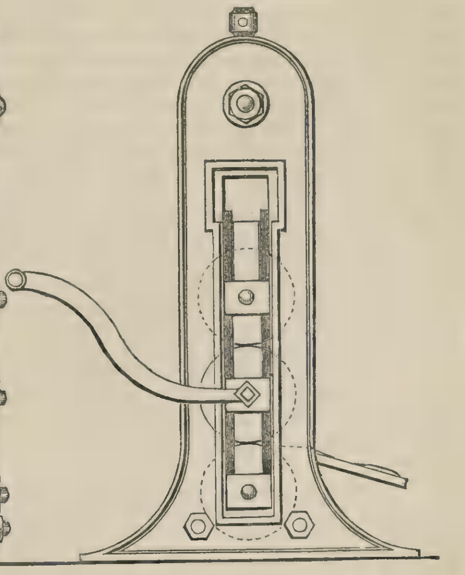


Fig. 2.



The entrance or feed-board of the mangle is attached to the frame, level with the line of junction of the two lower rollers, sloping downwards; and upon this board is spread out a sheet of linen, attached by one edge to the central roller. The articles to be mangled are laid upon this sheet, and motion being given to the central roller, by the winch-handle upon its shaft, they are carried in, and compressed between the whole three rollers.

The machine stands upon a superficial area of 32 inches by 10—being compactness itself—whilst its parts are simple, and easily kept in order. It is also said to impart a superior finish to the cloth.

ALUMINA, THE EARTH OF CLAY.

In our previous articles, "The Curiosities of the Application of Sand," and "Lime," pp. 12 and 207, vol. i., we have reviewed a few of the parts performed by two of the principal constituents of the earth's crust. The one now under consideration, Alumina, the peculiar earth of clay, is the next in order, and, at least to all who live between brick walls, possesses features of deep interest.

There is a peculiarity attending the presence of alumina in the mineral kingdom, which is not observable with sand or lime; it is the fact of its rare occurrence in a pure state, being generally found in combination with a large proportion of silica. If we adopt the favourite fundamental, or first cause theory of Socrates, that the universe exists as it is, because every thing has been created in the best way possible, we can very readily ascertain the reason of this difference in nature. Sand and lime, in a pure state, are applicable to almost numberless purposes in the economy of daily life, but pure alumina is useful only in a few instances, whilst its combinations are of universal importance, and are amongst the first substances that render aid to the infant-like progress of civilization; and they are not of value at the beginning only, but increase in importance just as rapidly as mankind learn new wants, and as civilization makes fresh demands upon the material world.

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* Our readers will please to correct the following errata in these articles. The most accurate calculation gives 7,912 miles as the earth's diameter. Consequently, the circumference is about 24,860 miles, and the rate of motion of an object at the equator is nearly 1036 miles per hour. The fall of bodies to the earth in the first second of time is 16.095 feet.

If the old pagan philosophy had not bequeathed to us the legend of Proteus, with his never ceasing changes, with each successive transformation bearing no outward trace of his previous form—modern chemistry would infallibly have led to the same idea. What more Protean than carbon, in its two well known forms of the dark and scarcely substantial cloud of smoke, and the hard and brilliant diamond? Whose eye but a chemist's, could recognise the masquerading element? But the transformations of the substances of which we have already treated, are of themselves sufficient to have embodied forth the moral of the mythological fable. We could not have an apter illustration of this assertion, than the existence of silica, in its splendid robes of state, as the clear-water-crystal of the Ceylon, the orient opal, the Scotch agate, and cornelian, and in its humbler and working-day costume of sand and flint. Lime also teaches the same lesson in its presence, as the splendid pearl, and curious and wonderful Iceland spar, and as the white chalk of the cliffs, and the mortar of our buildings. Nor is alumina silent, but from the precious sapphire and its cofrères, the oriental ruby and topaz, Proteus-like, it glides off to the hard, black, and ponderous emery, or to the soft, light, and tenacious clays.

In clay, alumina performs its most common and important functions; combined with silica and water, it then forms a plastic mass, present in nearly every habitable spot, and ready to become the yielding slave of man—so compliant to his will, that in ages long ago his own destiny and fate, so utterly beyond his control, were compared to the clay of the potter's wheel, in the hands of the maker, to be made or marred by the merest touch of the finger—by the slightest possible manifestation of *his* will. It is enough to mention clay, and the utilitarian character of the substance must be evident to all. Bricks and tiles of every shape and hue; vessels, coarse and common, yet useful as the best; vases and figures resplendent and graceful; some massive as metal, others light as lace, all display the properties and value of clay. Our two most excellent servants, yet unbearable masters, fire and water, are, as it were, fettered and confined to their bounds by clay. Our huge melting-furnaces, as well for the metal worker, as for the soda and glass-maker, and hosts of others—in short, all the crucibles and "vessels of the furnace," all the prison-houses of the fiercest fires—are made of clay; and yet water, the everlasting antagonist of fire, is equally resisted and held back by the same ready agent. Our mugs and cups, not to mention our draining tiles and water pipes, are sufficiently familar instances of water-holding vessels of clay; and when the hydraulic engineer makes an embankment across a valley to form a reservoir, mayhap to quench the thirst of some over crowded town, he builds a "puddle" wall of clay, to resist the escape and loss of water, and the consequent destruction of his work.

Those who are fond of speculating upon the paradoxes of nature, may meet with two remarkable peculiarities in water and clay. Every dabbler in science knows that bodies expand by heat and contract by cold. Water generally obeys that law, but for several degrees of heat before it is converted into ice, it *expands* as it *cools;* and water almost cold enough to freeze, yet still as liquid as ever, actually expands by cold. On the other hand, clay contracts by heat; placed in a hotter fire, a well burnt ball of clay becomes still less; and though this may in *some measure* be accounted for, by the gradual extrication of water, which, when once combined, is dissipated with the greatest difficulty, yet the whole of the phenomenon cannot be thus explained, for the contraction continues long after all water has disappeared; and clay will thus shrink within itself, until its specific gravity is nearly doubled, or two inches have contracted into the space of one.

The whole nature of clay is paradoxical. What more curious than its utter indifference to water after it has been burnt? *Combined* with that fluid, it is plastic and yielding; once take it away, and the former close friends are separated for ever, for water has no more action upon burnt, (*i. e., entirely dry clay*), than upon so much sand.

Professor Graham at one time inclined to the belief, that burnt clay and water might be made to combine, by boiling them together at a tremendously elevated temperature, and, of course, under enormous pressure. The experiment was tried by filling a gun-barrel with the clay and water, and after securely plugging the muzzle, surrounding it with an intense fire; but in spite of the great heat and pressure, the clay and water remained as distinct as before.

Few readers will dissent from the acknowledged opinion of the usefulness of clay, and therefore of its necessary constituent, alumina; but probably there are some of them who are not aware that the ruby is nearly pure alumina, which, in this state, so far from resembling its ordinary appearance in the soft, dull clay, closely approaches the diamond in lustre and hardness, and possesses an unparaleled beauty of its own, in its splendid colour; this, however, it owes to the presence of a small portion of chromic acid. The use of the ruby is not confined to merely decorative purposes; it is frequently employed in those branches of the industrial arts which require an exceedingly hard substance, capable of being pierced to form a fine and highly polished hole; accordingly it is much used for watch pivot-holes, and for drawing the finer kinds of wire.

Another of its useful forms is the emery-stone, which contains from 85 to 92 per cent. of pure alumina. Varieties of this stone are found in various parts of the globe, but the hardest specimens are brought from the island of Naxos, in the Turkish Archipelago. Few substances have more strikingly illustrated the effects of monoply in causing fluctuations of price, which, in this instance, has varied in a few years from £4 to £32 per ton. Another remarkable feature of the trade is, that the price of ground emery is always less than that of the raw stone; it must necessarily be adulterated, for we cannot suppose it to be ground for less than nothing, and in fact sophistication is seldom denied; but respectable dealers sell the article priced in proportion to its purity, and it is possible to obtain from some of the manufacturers a pure powder of emery. Still several large consumers always buy the stone and break and grind it themselves, the plate-glass trade almost invariably adopting this plan, as, for their purpose, it is requisite to have the emery as pure as possible.

Such are the principal uses of alumina in its natural state; subjected to the processes of chemistry, it enters a new field of action. Alum is chiefly valuable as containing alumina, and in this form it is frequently employed in domestic and various industrial purposes. In the art of dying, alumina is of the most essential service as a means of fixing colours, and of uniting them to the fabric; indeed, as a *mordant* or fixer of colour, it is almost indispensable, and the production of several colours is entirely dependant upon it. It is also largely used in making candles, and black and coloured crayons, and also in the manufactures of leather and paper, and too often by one who has no business with it—the baker—who thus whitens his bread at the expense of his customers' health.

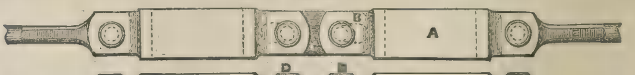
In thus tracing a few of the more transparent peculiarities of the three principal earths—sand, lime, and clay—our object has been, by using popular and well understood terms, to draw attention to points, which, under the attempted elucidation of chemical phrases and symbolical formula, are at once rendered repellent and obscure. For a due popular appreciation of the beauty and extraordinary aptitude of nature's elements, we must have a popular system of description. The further we can extend a knowledge of such apparently simple matters, by so much the more is the wonderful perfection of the creation comprehended; and in such case, the universal *pre-adaptation* of all the varied forms of matter to the ever increasing wants of man, are evidenced in a clearer light.

D.

WILLIAMS' BUFFING AND DRAWING APPARATUS.

Mr. Charles Cave Williams, of the London and Bristol Railway Works, Gosnell Street, London, has registered a modification in the connections of buffing and drawing apparatus for railway carriages, which, whilst it is extremely simple, effects an important improvement in this class of mechanism of conveyance. In spring buffers and drawers, as now in use, the strain, under both circumstances of action, comes upon such individual spring separately; and the advantage of two springs is, to a great extent, lost. Our two engravings will explain how this objection is obviated, by throwing the strain upon both springs at once. Fig. 1 is a side elevation; and fig. 2 a plan of the spring connections, the springs themselves being removed. A A, Are the hoops or straps for holding the springs; and at the back of each of these hoops is forged a double eye, B B, the two being connected by a short bar, C. This bar is slotted near

Fig. 1.



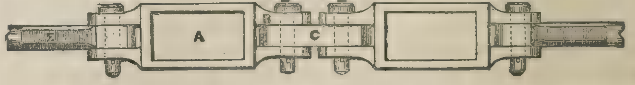
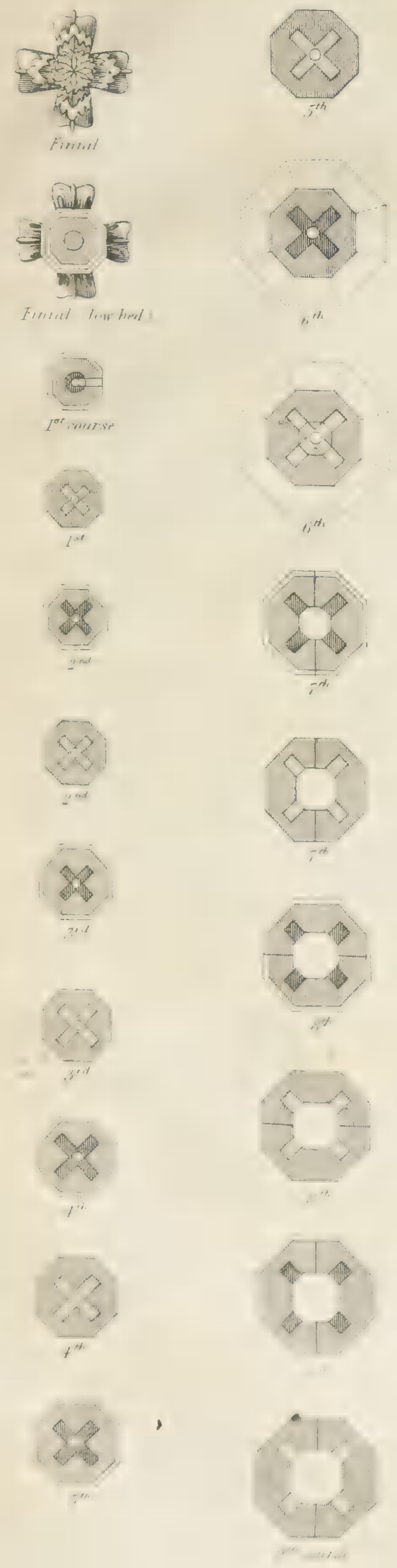
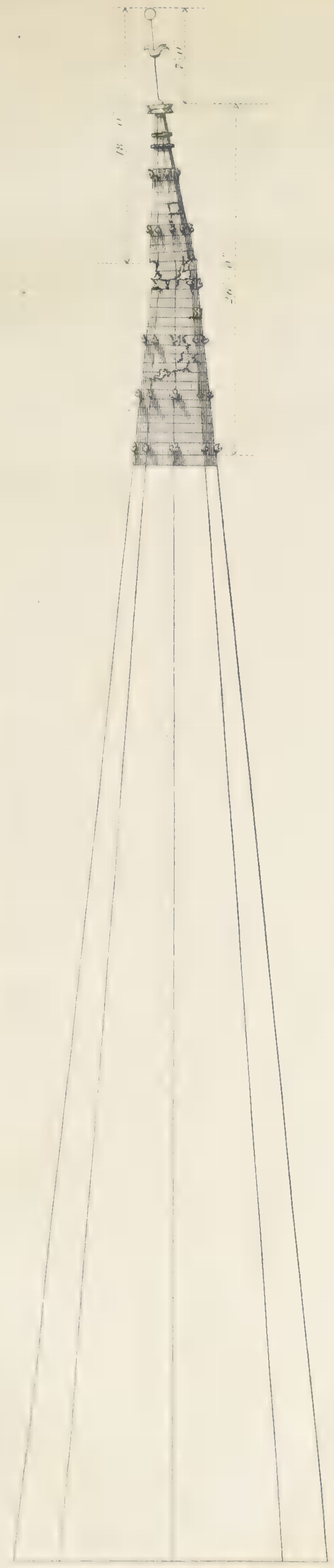


Fig. 2.—1-12th.

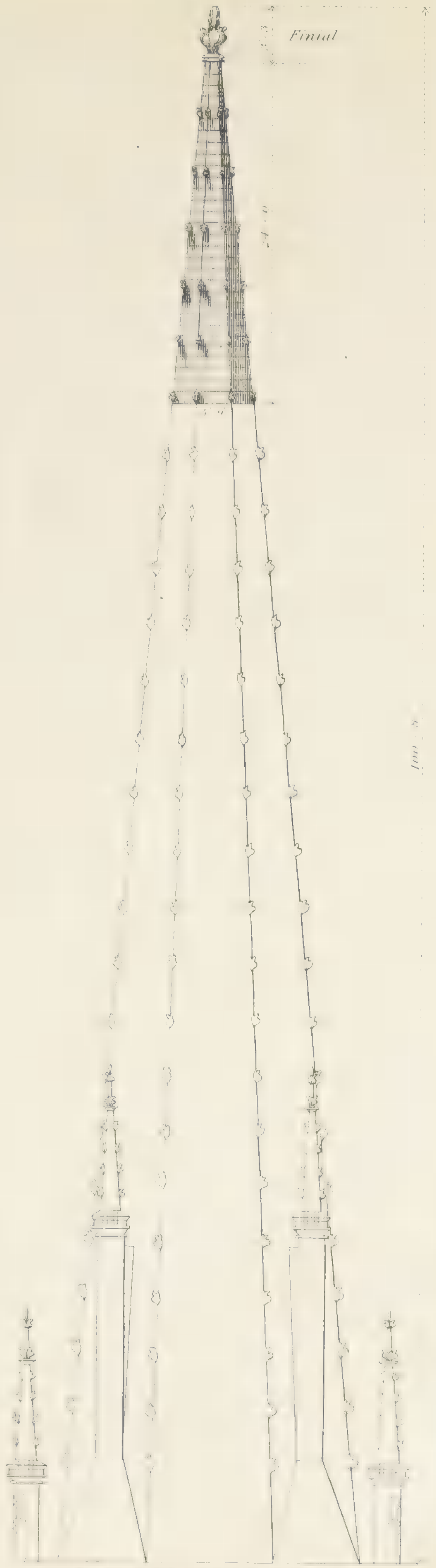
ROTHERHAM CHURCH SPIRE.



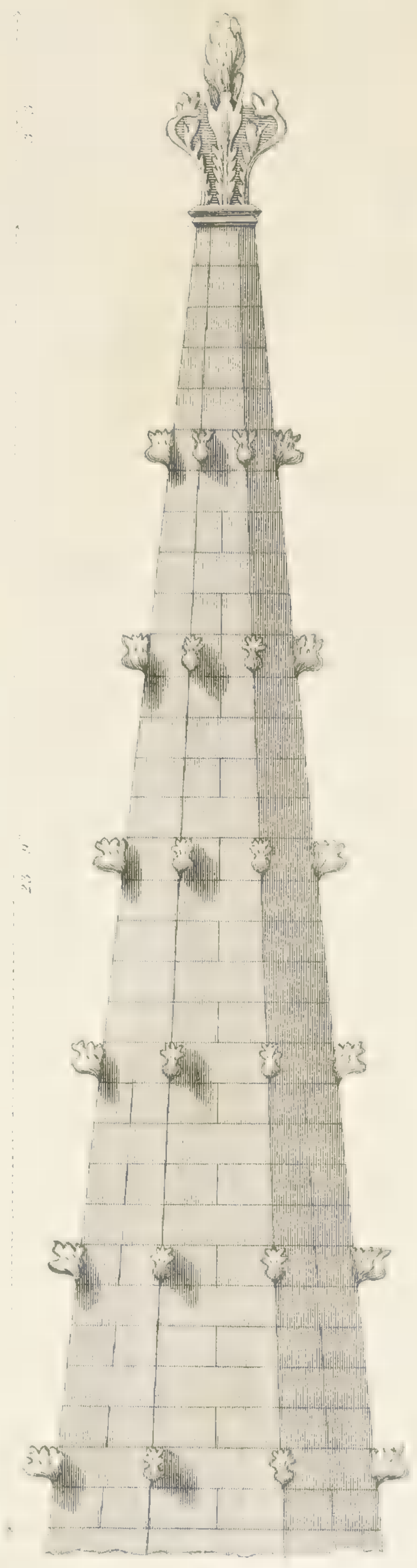
PLANS



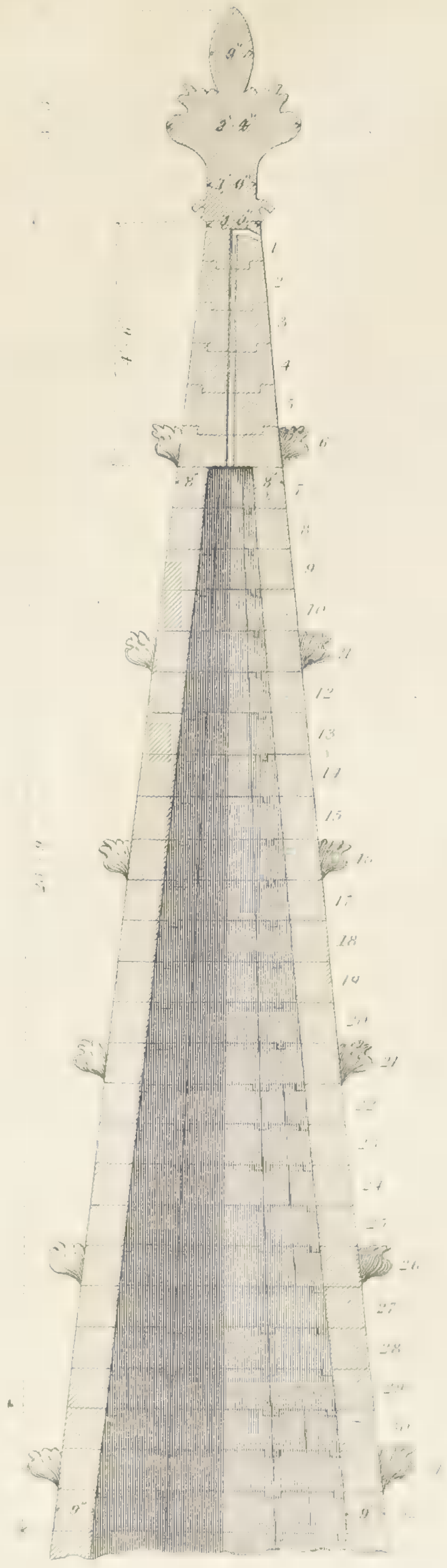
THE OLD SPIRE



THE RESTORED SPIRE

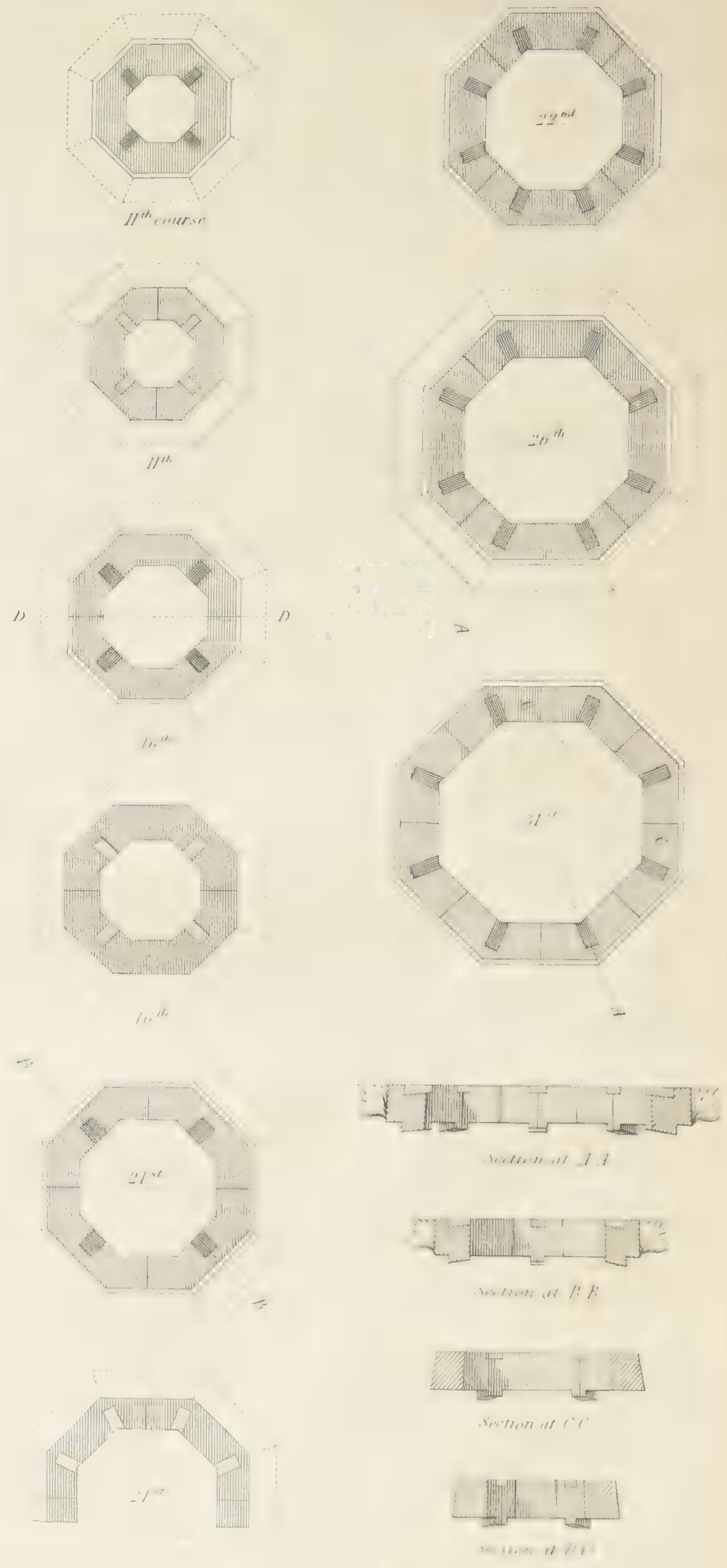


ELEVATION



SECTION

Scale for old & restored Spire



PLANS

each end, to receive the pins, D D, and to allow of a slight horizontal motion to the extent of such slots. The front side of the spring hoops is of the same construction, having double eyes to receive the ends of the draw-bars, E E, which are provided with flanges at their opposite ends, so that, when necessary, they may take a bearing against the head-stocks.

In the drawing action, as the tension comes on the apparatus at either end, one of the pins, D, traverses its slot until it comes to a bearing at the termination of the slot; and during this period, the compression has been reduced proportionably on the other spring, and it has, consequently, followed up the movement, the tension then coming upon both springs at once. This continues in all ordinary work; but to prevent the back spring from losing all its compression, as might occur when the pull is very heavy—in the case of the last waggon of a long train, for example—the collar on the draw-bar comes against the last head-stock.

In buffing, the springs act under a totally different form, as they mutually back against each other, giving an available power of two springs, whilst, for light concussions, the elasticity of the single spring is retained. The arrangement is easily applied to carriages or waggons as a substitute for the present system.

RESTORATION OF ROTHERHAM CHURCH SPIRE.

(*Illustrated by Plate* 28.)

The spire of Rotherham church was struck by lightning in the month of July, 1830, breaking out several of the courses of masonry, and cracking and shaking the whole area for some thirty feet downwards. As the repairs of the damage afforded some peculiarities of architectural construction, we have engraved the upper portion of the spire in its injured, and in its restored state, with a series of the courses of masonry.

In plate 28, the range of figures on the right and left exhibit a plan and under-view of the *Finial;* the upper and lower views of the courses of masonry, from the 1st to the 9th, with the addition of the 11th, the 16th, 22d, 26th, and 31st; and a vertical section of the 16th, the 21st, and one of the 31st courses. The remaining figures show the state of the spire after being struck, and when restored; with an elevation and section of the upper portion on a large scale.

As a key to the minuter details of the drawings, we append the particulars of the specification:—

SPECIFICATION FOR THE MASONRY REQUIRED IN TAKING DOWN AND REBUILDING A PART OF THE SPIRE OF ROTHERHAM CHURCH.

Taking Down.—The old material must be carefully taken down, and delivered in the churchyard, and whatever damage may be done by the contractor or his men, either to his own work, or to any other part of the building, the same must be made good at the contractor's expense.

Shed.—The contractor must erect a shed (20 feet by 9 feet inside) in a convenient part of the churchyard, for the workmen, in order to prevent any delay on account of the weather.

In front of the shed, a platform must be made, of two large flags, to fix each course of ashlar upon as it is wrought, in order that nothing may have to be done upon the scaffold, except merely to set the ashlar. The shed, and the area in front of it, must be properly fenced off with rails and slabs, seven feet high from the ground, the same to have a door four feet wide, and a lock, to prevent boys from damaging the stone work.

Scaffolding.—The scaffolding must be constructed in the most secure and proper manner, to resist the force of the wind, and in every way adapted to the security of the workmen, and the speedy execution of the works; to commence at the foot of the spire upon a framework of timber, and to be carried regularly upward until a pair of shears and blocks can be firmly fixed, to take down the old work and set the new.

Gangway.—A gangway, securely constructed, and properly guarded or barricaded, must be made from stage to stage, in order that the architect may at any time ascend to inspect the works. No old ropes will be allowed to be used in or about the scaffolding, and every plank must be properly secured to the putlocks, in order to prevent accidents.

Repairs.—As the old part of the spire below the new will be repaired to an extent which cannot at present be ascertained, and as the repairs will probably be let by contract, it is to be particularly understood that the scaffolding, ropes, ladders, and every other implement and machine, are to be entirely at the disposal of the churchwardens, until such repairs be completed. An allowance for the same to be made at the discretion of the architect.

Ashlar.—The ashlar must be procured from the Broom quarry, and wrought according to the templates, which must be constructed according to the plans.

Finial.—The finial must be in one stone, and wrought according to the drawing, No. 1, and the section, No. 2, the bed being morticed, or sunk into the top bed of the first course.

Crockets.—The 1st, 2d, 3d, 4th, 5th, and 6th courses must be each in one stone. The low bed of each must be morticed or sunk into the top bed of the stone underneath it. There must be eight crockets wrought in the 6th course, to project about six inches each, for which crockets a drawing will be given at large.

Tenons or Keys.—The courses from the 7th to the 21st, inclusive, will be each in two stones; each stone must have two tenons, or keys, three inches broad on the low bed, and to be cut not less than 3 inches from the face of the stone, and project from the bed 1½ inches at one end, and 1 inch at the other end, or the inner face of the ashlar. The top bed of each stone must have two mortices or sockets in each, to receive the tenons of the upper stone, 3½ inches broad, 3 inches from the face of the ashlar, and to be sunk 1¼ inches deep at one end, and 1¾ at the other.—See the sections.

Crockets.—The 11th, 16th, and 21st courses being each in two stones, there must be four crockets upon each stone similar to those before mentioned.

The tenons or keys in these, and all the stones below, must be 4 inches broad; 3½ inches from the face, and to project from the bed 1½ inch at one end. and 1 inch at the other end, or the inner face of the ashlar.

The courses, from the 22d to the 32d inclusive, must be each in four stones; each stone having two tenons, &c., as before specified.

The 26th and 31st courses, being each in four stones, there must be two crockets wrought upon each stone.

Cement.—There must be an opening cut through the centre of the 1st, 2d, 3d, 4th, 5th, and 6th courses, from 3 inches diameter at the bottom, to 1½ inch diameter at the top, in order to allow the cement to escape out of the mortice, so that each stone will set well upon the bed, and the cement must be taken out of the opening immediately after the stone is set.

The opening must be returned through the ashlar, immediately under the base of the finial, to allow a constant current of air to pass through the spire; an opening also must be made 3 inches in diameter, in such parts of the ashlar as the architect may direct.

The ashlar must be set with the best "Portland cement," and clean, bright river sand (the sand must be perfectly dry when mixed with the cement), mixed in proportions of two parts sand to one part cement, and should it set too soon, a larger portion of sand must be used.

Setting.—After each ashlar is lewised, the stone must be washed, and brushed clean from all dirt, and the smithin which is left by the tool; then to be drawn up to the scaffold, and again watered before it is set. Every ashlar must be wrought to lay upon its natural bed, and no stone which has the least crack, shake, or any other imperfection about it, will be allowed to be set.

Finial.—The finial must be got to lie or stand upon its natural bed; that is, it must be cut out of a bed of solid stone in the quarry, at least 3 feet 6 inches thick.

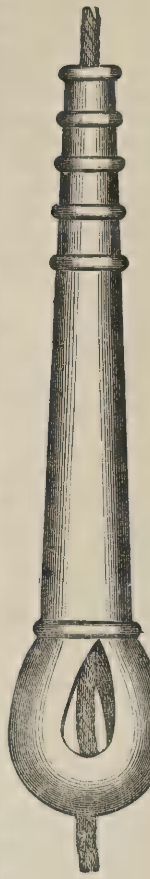
Pointing.—The joints of the ashlar must be pointed as the work proceeds, both inside and outside; and, after the finial is fixed, the whole of the new work must be well washed down with pure lime water.

Rubbish.—When the works are completed, the contractor must remove entirely away all the rubbish off the building, and out of the churchyard. The ashlar must all be wrought in the churchyard, in order that it may be under the inspection of the architect. The contractor must provide proper templates, battering rules, &c., requisite for the accurate working and setting of the ashlar. The contractor will not be allowed to relet the working of the ashlar to his men, without the consent of the architect in writing. Should the architect find it necessary, the contractor will be required to employ a carver to execute the crockets and the finial. All the ashlar must be neatly tooled outside, the angles being perfectly true; and the inside, beds, joints, &c., must be boasted.

The drawings afford their own explanation. Mr. Lister, C.E., of Conway, North Wales, was employed as architect for taking down and reinstating the portion of the spire, and likewise the pinnacles on the west end of the church, which pinnacles deserve inspection.

JONES' FIRE-ESCAPE.

It has been truly observed, that in the high and hot pursuit of improvement, an objectionable degree of complexity has been too often disregarded in the endeavour to compass many points at once, whilst simple means, better fitted for the purpose, have been quite overlooked. We have an example of this fatality in the clever and original fire-escape lately invented by Mr. Richard Jones of Ipswich, the simplicity and beautiful efficiency of which puts to shame the bulk of the more pretend-ing schemes proposed for the same purpose. It is not, in itself, intended entirely to supply the place of some other arrangements which profess to furnish the perfection of the means of descent; but our sketch will show in how far it may be applied, either in connection with existing contrivances, or, as we are about to describe it, as a ready instrument in itself.



The engraving is an elevation of the escape, which is nothing more than a tube of vulcanized india-rubber, slightly tapered, having, at its upper end, a few plain mouldings, or projecting rings, by which to hold in descending, whilst the lower end widens out to form a loop. This tube is passed upon the rope which is to be used as the medium of descent from an upper apartment, where it is to be attached, to the ground. The rope has a hook at its upper end, by which it is suspended from a screw-eye fixed in the wall, above or on one side of the window; the tube is then slipped up the line until the loop at the lower end is just breast-high at the level whence the descent is to be made—the end of the rope beneath the tube being thrown over the edge of the window to the ground. The party about to descend then suspends himself from the loop by a band passed round the body beneath the arms. So long as the weight of the body acts only upon the loop-end of the tube, no descent will take place, for the tension will cause the tube—the bore of which fits well to the rope—to elongate and attach itself very powerfully to the rope's surface. To descend, a portion of the weight must be transferred to the upper end of the tube, by grasping the moulded portion with one hand; the tube will then begin to slide down the rope with more or less rapidity, dependent upon the amount of tension transferred to its upper end, whilst one hand is still left to guide with.

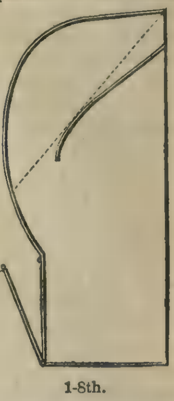
This action of the tube is dependent upon the peculiar property which india-rubber possesses, of strongly resisting any attempt to draw it by its foremost end along a line or rope, arising from the elongation of the elastic material causing a proportional diminution of the bore, thus grasping tightly to the surface which it embraces. The tapered form is given to the tube for the reason that, as the elongation gradually diminishes upwards from the end subjected to the strain, it is necessary to make it gradually weaker, to give each portion a due amount of hold.

When pushed along from the hindmost end, the tube slips with perfect ease, as the compression of the material, in the direction of its length, tends to widen the bore. This property has been elegantly turned to use by Mr. Jones, in adapting it as a medium of descent from great heights; for any one using it has the immediate power of arresting his descent in an instant, by withdrawing his hand from the upper end of the tube, and the speed of movement may be regulated most perfectly by giving more or less weight to this point. This may be taken advantage of in entering any window or door beneath that from which the party has commenced his descent, should it be desirable to do so to rescue others. When several persons are to descend by the same escape, the second must draw up the rope, after the first has reached the ground, until he can lay hold of the larger end of the tube, which he must then slip along the rope until it arrives at the proper height for his descent.

An arrangement so easily fitted up, and put into action as this, is to be regarded as much more valuable than any of the more elaborate contrivances, which take time and mechanical skill to get into play. For all able-bodied persons, with tolerably stout nerves, the apparatus will of itself answer as a complete means of descent; for others, a basket might be attached to the loop of the tube.

WARNER'S SAFETY LETTER-BOX.

We have before us a specimen of an office letter-box, manufactured by Mr. James Allan, sen., of Buchanan Street, which is peculiarly arranged for the prevention of the clandestine abstraction of letters or parcels deposited within it. In the ordinary box, with a direct slit, there is nothing to prevent the entrance to the interior, of a wire or thin slip of wood, by which the deposited papers may be, and are frequently, withdrawn. As a simple safety apparatus for obviating the risk of this species of theft, Mr. Warner has introduced the box illustrated in our accompanying engraving.



The figure represents a vertical section of the complete box, drawn to a scale of one-eighth, the actual size. The upper portion of the box is rounded out to a considerable curve, projecting a little forward; and from this form, in connection with the division-piece in the upper part, arises the security of the new arrangement. This division is soldered or fastened to the tin sides of the box, commencing at the edge, which is screwed to the door, and follows the course of the external curve of the top, to about the middle of its curve; so that, when a letter is dropped into the box, it glides over the division, and falls into the rectangular bottom, where there is a small door, opening into the room, for its extraction by the owner.

It is impossible to see any article laying in the box, from the outside of the door; and even if anything is introduced through the slit, it cannot proceed farther than the position of the dotted line shown resting upon the top of the division-piece, unless it is highly elastic; and then its tortuous passage must be an effectual bar to the withdrawal of the contents. The improvement adds a mere nominal amount to the cost of construction of the ordinary plain receiving-box, whilst its advantages in point of security are obvious.

THE RIVER CLYDE.

Harbour and Railway Improvements.

(*Illustrated by Plate* 29.

In continuing our illustrations of the engineering practice of the Clyde, we this month present a plate of more than our ordinary size, exhibiting a plan on a scale of 1 inch to 400 feet, of the Harbour of Glasgow, or Broomielaw, extending from a short distance below Stockwell Bridge, down to the proposed Stobcross Docks; with a series of thirteen sections of the river walls and steam-boat piers, on a scale of one-sixteenth inch to a foot. The increased scale will enable the relative positions and areas of the several docks to be easily understood—as also the improvements coming under the term of the Mineral Harbour Terminus, to which reference was made in our notice of last month.

The principal dimensions of the several walls are marked on the sections, but the details of these walls, as well as the general features of improvement in the river course, where it forms the harbour, must remain untouched, until we have an additional plate of further details of interest, for our June number.

RECENT PATENTS.

TURN-TABLES.—Alexander Turiff, Engineer, Paisley.—*Enrolled Dec.* 23, 1848.

The improvements introduced by Mr. Turiff, have reference, more particularly, to turn-tables of large size, such as are employed in turning an engine and tender at once. The first portion bears upon the obtainment of steadiness and freedom from vibration during the passage on or off, of engines or carriages. The main fixed supporting centre of the table is carried by a polygonal cast-iron frame, to which are bolted a series of cast-iron radiating arms, the latter being again bolted at their contrary or outer extremities, to the inner sides of the trace-rail segments, upon which the supporting or trace-rollers are carried. The top of the main-centre casting, is bored out to a slight depth to receive the slightly rounded end of the main-centre journal, which is a short cylinder strengthened by feathers, and cast with a top circular plate for bolting to the upper surface of a rectangular open frame, carrying the centre guide rollers.

The slight concavity of the main-centre admits of an easy adjustment on any required side, by means of a set of four retaining rollers, carried by the rectangular frame just mentioned, so that the whole table can be at once accurately set by moving in or out, any one or more of the stud spindles of these rollers. The adoption of a short main-centre journal also admits of tables being put down in situations where the ordinary deep centres are quite inapplicable, on account of the depth of masonry required. In the second place, the usual malleable iron radiating arms for binding together the framing, are entirely dispensed with, and in their place, the patentee employs two parallel beams running right across the table, and set a short distance on each side the main-centre, so as to embrace the sides of the rectangular casting bearing the retaining rollers, and from these beams springs a strong rectangular framework of cast-iron bolted to the external ring of the table. Thirdly, a substitute for the ordinary malleable-iron circular framing, employed to guide the trace-rollers, is provided. A double panelled cast-iron ring of segments bolted to each other, and to the ends of the beams forming the rectangular framing, carries the trace-rollers, of which ten only are shown in the drawing before us. The rollers are placed between the two panelled rings, and are retained by pedestal caps bolted underneath.

An important modification is also introduced as a preventive of all or most of the strain to which the framing of the common turn-tables is subjected, by the variations or irregularities of the top and bottom trace-rail. The upper rail is dispensed with, and the rollers are guided entirely by the bottom one, being fast on their axles, which revolve with them.

The arrangement of the parts forming the top ring of the table, as previously explained, produces a most substantial frame, involving much less labour and metal, than is usual in ordinary tables. The table is turned in the usual manner, by pinions working into segmental racks, cast on the inner surface of the circular framing.

The claims are—"the constructing of turn-tables with shallow main-centres, fitted with adjusting rollers and shallow journal bearings; the dispensing with the radial or spider arms; as also the usual malleable iron circular framing; substituting in lieu thereof, the framing described; the mode of placing or attaching the trace or supporting rollers to the lower side of the upper cast-iron segments; the constructing of tables with one trace-rail only, and lastly, the general arrangement of the table top."

REVIEWS OF NEW BOOKS.

Railway Economy: an Exposition of the advantages of Locomotion by Locomotive Carriages instead of the present expensive system of Steam Tugs. By Lewis Gordon, C.E., Regius Professor of Civil Engineering and Mechanics in the University of Glasgow. Edinburgh: Sutherland & Knox; Simpkin, Marshall, & Co., London. Pp. 67.

The tide of controversial discussion on the mechanical engineering of railways has, after passing through various fields of inquiry, at last set in upon the subject of *light versus heavy locomotive engines;* and the interest which has been, for a variety of reasons, attached to that subject since the introduction of Adams' locomotive carriage, has induced various inventive geniuses to follow in the same track, and already we have on the rail above half a dozen rival locomotives, of miniature dimensions but with great hearts, threatening to run down the overgrown and plethoric giants which have hitherto monopolised the iron courses of our country. The advocates of very light engines have found a zealous, though, we fear, not a very practical supporter in Professor Gordon, in whose work on Railway Economy it is endeavoured to be proved that greater commercial advantages are to be secured, both to railway shareholders and to the public, by substituting locomotive carriages for the present locomotives and carrying stock. The particulars of the performance of the locomotive carriages are already published in our first volume; the carriage to which we shall more particularly refer, for comparison with the large locomotives, is the "Fairfield," built for the Tiverton Branch of the Bristol and Exeter Railway. It is compared with the "Great Britain" broad guage engine from the Swindon factory; the comparison is therefore between two broad guage engines of the largest and smallest class respectively, and affords a fair means of testing the maximum and minimum capabilities of locomotives now in use. The principal weights and dimensions of the two engines are as follow, those of the Great Britain being derived chiefly from the Report of the Commissioners of Railways, 1848:—

Great Britain—	Weight of engine and tender, with coke and water,	50 tons.
	Weight upon the driving wheels,	12 "
	Diameter of cylinder,	18 inches.
	Length of stroke,	24 "
	Diameter of driving wheel,	8 feet.
	Area of blastpipe to area of cylinder,	1 to 13
Fairfield—	Weight with coke and water,	16 tons 10 cwt.
	Weight upon the driving wheels,	7 " 15 "
	Diameter of cylinder,	8 inches.
	Length of stroke,	12 "
	Diameter of driving wheels,	4 feet 6 inch.
	Area of blastpipe to that of cylinder,	1 to 20

In comparing the useful effect of each class of engine, in proportion to the power expended, Mr. Gordon takes a narrow guage table of resistance, compiled from the working of a French engine, the Gironde (weighing, with its tender, 26 tons, having a 3 inch blastpipe, and 5½ feet driving wheels), with the object of proving that, with a load of 46 tons, the resistance of engine and tender alone was, at 32 miles an hour, 1017 lbs.; that the resistance of a weight of ordinary carriages, equal to that of the engine and tender, was 364 lbs.; that the friction and other resistances of steam machinery, deduced by substracting the latter from the former, was 753 lbs.; and that the total power of the engine was 1706 lbs. These results of course stand in formidable array; as, however, they are founded on the working of a French engine, they may, for present purposes, be placed *hors de combat*, especially as we can institute a comparison with the results of home-made engines.

In making this comparison, we may take the speed of 45 miles per hour, as that which has to be maintained between the stations by ordinary trains with each class of engine. Referring to the indicator card No. 3, taken by Mr. Gooch, from the working of the Great Britain, and published in the aforesaid report, it appears that, with a blastpipe and cylinder whose areas are as 1 to 13, and with steam cut off at 13-24ths, the back pressure was 17 per cent. with an 8 feet wheel. As the per centage increases nearly as the velocity of the piston, we shall have, *cœteis paribus*, with the 4½ feet wheels of the Fairfield, a loss from back pressure of about 30 per centage. Again, Mr. Gooch remarks that "the friction of the pistons and glands," referring to the proportion of large and small engines, "remains in the ratio of their diameter only, while the power increases as the squares. The same principle applies generally throughout the whole of the working parts of the machinery." A similar remark may be made as to the proportionate weights of the reciprocating parts, and is thus stated by Mr. Gordon himself:—"The absolute power of the engine is increased in a greater ratio than the absolute weight, and we may therefore conclude that in the locomotive question, *per se*, it is better to employ one heavy engine than two light ones to do a given amount of work." This argument agrees with what Mr. Gooch has stated to the Railway Commissioners on the economy of a large boiler when working light loads. It is a well ascertained fact that a given quantity of fuel will evaporate more water, when consumed at a moderate heat, than when fused by a powerful blast; similarly, a large body of fire will require less blast than a small one, and accordingly, while Mr. Gordon observes that "the new machines' boilers are as well proportioned as the best boilers now in use," the proportional areas of the blastpipes are as 13 to 20 against him.

A special comparison of the performances of the Great Britain and the Fairfield, can, in justice, be made only on considerable lengths of line. The means of instituting such a comparison have been supplied in a late number of the *Morning Herald*, of which we insert the following account, with the remarks thereon. The comparison is made with the Great Britain, running with the night mail train. The trip with the Fairfield was from Exeter to Bristol, with a loaded waggon weighing 10 tons. But, to give the result of its working, it is necessary to divide the total weight of the Fairfield into what is due to the engine, and what is due to the carriage. As already noted, the weight on the driving wheel is 7 tons 15 cwt. We may add to this about 1 ton 15 cwt. as carried by the wheels of the carriage, making a total of 9 tons 10 cwt. for the weight of the engine; the carriage, therefore, weighs about 7 tons 5 cwt. The total weight of the carriage portion of the train was therefore, say, 17 tons. On the day of the experiment, the Fairfield was despatched immediately after the 8 a.m. train from Exeter, for the purpose of ascertaining whether she could, with the 17 tons behind her, run the distance, 76 miles, with 10 intermediate stoppages, in the ordinary time, 2 hours 35 minutes. The Fairfield, making allowance for two extra stoppages, occasioned by obstructions on the line, was 3 hours 17 minutes doing the journey, and the consumption of coke was 13 lbs. per mile, the evaporation of water being 6·3 lbs. per pound of coke per mile. The night mail train is a much easier one to work than the 8 a.m. from Exeter, inasmuch as there are but eight stoppages between Paddington and Swindon, 77 miles distant, and the stoppages are of shorter duration; but the time allowed for the journey of 77 miles is 2 hours 45 minutes, while the Fairfield was 3 hours 17 minutes on the 76 mile trip. For the extra stoppages made by the Fairfield we have the 77 miles done in 32 minutes less time by the Great Britain than the 76 miles were performed by the former. The two extra stoppages made by the 8 a.m. train, and the longer stoppages at the stations, may be taken at about 18 minutes, so that the little engine gets the advantage of about 14 minutes, which is in fact placing in the scale in her favour, the amount of the coke that would be consumed in the increase of speed necessary to make up the loss of 14 minutes on the whole journey. The duty performed by the two engines would, with the allowance just stated, stand thus:—

	Load in tons.	Coke per mile.	Consumption of coke per ton per mile.
Great Britain,	100	26 lbs.	0.26 lbs.
Fairfield,	17	13 "	0.76 "

This appears to show that the loss by the small engine is so great, as compared with the larger one, that, with less speed, her consumption of coke is three times as great. We are, however, satisfied that the working of the night mail for 26 lbs. of coke per mile is below what the engines with all the other heavy stopping trains consume. Allowing the 8 a.m. train, with its ordinary load of 40 or 50 tons, exclusive of engine and tender, causes the consumption of 26 lbs. of coke per mile, the train would nevertheless accommodate, with composite carriages, 300 persons; while the Fairfield, with her 17 tons, would accommodate only 96 persons. Again, the ordinary broad guage engine will take seven or eight carriages, or 600 passengers, at the same speed for about 33 lbs. of coke per mile, but to do the same work would require six Fairfields, with twelve drivers and stokers, instead of two, and a consumption of 78 lbs. of coke, instead of 33 lbs.

We have probably gone sufficiently into the merits of the question of locomotive carriages *versus* steam-tugs, as they are characteristically designated, to show the inapplicability of the former class of conveyance for the main traffic of railways. It rests with the promoters of the locomotive carriage to show, more convincingly than they have yet done, the advantages of the lighter over the heavier engine for general purposes. We believe that, like the atmospheric railway system, the locomotive carriage will be found advantageous only for short traffic, such as occurs on branches and other subsidiary lines. It has been too well established by experience to require any confirmation at our hands, that locomotive transit in large masses and heavy loads, by means of suitable propelling power, is the most economical species of through traffic. Of course, it is very obvious, that in occasional instances, such as frequently occur on our northern railways, where perhaps a luggage van and a first-class carriage together constitute the substance of a train, it would be more economical to provide a smaller and more suitable engine to move it. On our first class railways, however, and it is to them that Mr. Gordon especially refers, it will ever be found impolitic to subdivide the traffic into smaller and disjointed portions. The responsibility of conduct would be divided amongst a greater number of conductors; and were the hundreds of even heavy trains which already pass through our central stations to be broken up into fragments adapted to the power of a locomotive carriage, risks and consequences of collision and other accidents, would be infinitely increased.

We can but touch upon one other feature in the construction of locomotive carriages—the placing of engine, tender, and carriage on one frame. This arrangement is both unnecessary and objectionable. In point of weight of material, the introduction of an additional pair of wheels in the event of separating the engine from the carriage, would be an inconsiderable item of weight, and the saving of weight by the adoption of the joint frame is of no moment. Neither is the joint frame necessary in point of steadiness, as the engine might easily be screwed up firmly to the carriage with elastic buffers, and receive abundance of steadiment therefrom, as is now commonly practised in forming the connection of heavy engines and tenders. At all events, Crampton's patent arrangement of wheels might be beneficially adopted. But the joint frame is positively objectionable, as the great distance between the extreme bearings under the machine is unsuitable for quick curves, unless abundance of lateral play on the journals is allowed. It has already been stated in our account of the Fairfield, that the wheels are loose on the axles, and the axles loose in their bearings; this is to facilitate the passage of curves, and it must be viewed only as an expedient necessary to meet an unnecessary difficulty.

Finally, while we believe Mr. Gordon to be a sincere and zealous advocate for the locomotive carriage, he can only be viewed in the light of a partisan, and his pamphlet as a piece of special pleading, which has at least the merit of setting forth the more vulnerable properties of what he is pleased facetiously to denominate the present system of locomotive tugs.

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CORRESPONDENCE.

THE RESISTANCE TO RAILWAY TRAINS.

Whatever may be the impressions of the readers of this Journal on the matter in controversy between myself and H. W. of Paddington, I will remind them, that unsupported assertion is no proof, and that he has not yet advanced an argument or fact tending to invalidate any one point set forth in the original paper which gave rise to the discussion.

In his last essay he has inadvertently plunged into a mistake common to those who have a weak case to defend, viz., he has misplaced facts in saying I have picked out *one* experiment, and then constructed a formula, &c.—had I done which, I would admit the action to be "absurd and childish," as he says, and even so in degree, as have been all attempts hitherto made by engineers and experimentalists, to determine the power requisite to produce given effects on railways, when these effects are the sum of various and distinct resistances, subject to different laws, and without taking or estimating such resistances *separately*.

Let, then, H. W. remember I have not yet descended so low as to make a formula to agree with an experiment in any such like case, as others have done, and that I have not engaged in an act so "absurd and childish" as that with which I am charged; but should he be in ignorance of the formula having been both constructed and in print long before the experiment was begotten or thought of, the fault is his own, as in my first paper on the subject, a reference is given to the book containing it. Let him then *try back*, and see how he could fancy that I had fallen into the very error which I was charging to others; but should he fail to explain, his friends will surmise either that his mistake was deliberate, or his cause bad.

The charge, therefore, now stands gravely thus—that my formula has been applied to *one* experiment only, and agreed therewith, too minutely to satisfy his taste, and that of the "several practical engineers with whom he has lately conversed." Nevertheless, I am ready to apply the same to fifty other cases, provided H. W. will furnish such data that I shall have nothing to assume, and provided also the editor of this journal may think such ponderous computations valuable to his readers.

H. W., finding that he could no longer stand his ground amongst people of common understanding, has withdrawn the charge of my having neglected to account for the effects of a side wind, when not a breath of air was stirring; but, as a last resource, it is revived in another form, by "supposing the wind will blow some time or other, and therefore a proviso should have been made in my *trashy* formula." My plain answer is, that when railway directors have the control of the winds, or railway wisdom decides that, however hard the wind may blow, the speed of the train shall be at a given rate, the formula shall be extended accordingly; but, until then, let it stand as it does, showing the resistance of the air at rest to a train progressing through it.

H. W. may feel himself refreshed in fancying that I am to be led from the main point at issue, or simple enough to take offence at the application of the term "snarling" to my communications, and that I shall quail at his third repetition of my "delight in finding fault," as if I had not both given ample reason, and proposed a remedy; but he shall neither so effect his purpose, nor divert the public attention from plain facts by talking about his indicator diagrams.

These last named indispensable fashionable things represent only the nominal power of the engine, or that of the steam. How much thereof is expended on friction, and a strange variety of other insensible things, which could be particularized—and, amongst the rest, how much of it, in certain cases, is wasted by the slurring of the driving wheels on the rails—is what I ask for; but it will be a secret not to be told until a dynamometer be placed between the engine and train, after which, I repeat, that shareholders will have an account by "double entry," and therein see how much fuel is unwarrantably consumed—a proof which will not be very flattering to the engineering talent of H. W., or his several practical friends.

As to the said diagrams in steam navigation—when the resistance to a vessel shall have been properly ascertained by the dynamometer, I venture to say it will scarcely exceed one-eighth of the power indicated, an assertion which will be proved, or otherwise, whenever it shall have been deemed prudent to determine the fact by experiment, at the cost of a few tons of coal; but notwithstanding the prevalent reluctance to such downright double-entry proofs, I shall hold the neglect as a slur on the mechanical tactics of the advisers, both of the Government and others, who hold such paid men in commission.

With a bad grace, H. W. still objects to my having said, that engineers, notwithstanding all their experiments, aiming to settle a complex question as if it were a simple one, have as yet discovered nothing but their own confused and conflicting notions of the principles of locomotion on the rail, and I now refer him, as a more competent authority than myself, to the words of Mr. Scott Russell, who, when chairman at the York meeting of the British Association, said,—"How much mechanical force is requisite to move a given weight of train along a given gradient, at a given speed, was a question of which the solution was essential to sound engineering; but the profession have long felt they were not in possession of sufficient data to determine the question."

What better authority can H. W. expect; but if data be all that is wanted to perfect sound engineering, why has it not come forth when so many millions have been recklessly expended; or rather, may it not be assumed there is a lack of tact and talent in applying the fund of data already on hand.

It is satisfactory to perceive that my antagonist in mechanical warfare may happen to know the relation between the temperature and pressure of steam perhaps as well as myself. Perhaps it may happen so, and perhaps it may happen otherwise. The subject is such, that both *happen* and *perhaps* shall go overboard, and other people shall judge between us. It is, however, of such moment, that I request the editor will allow it to stand under a distinct head, rather than at the fag end of an argument with a nonentity, shrouding himself from responsibility under two mean inarticulate capitals without their supporters, an artifice in literary warfare as unmanly as that of one in a duel being clothed with under-mail, when his adversary is unprotected. In taking leave of my disguised antagonist, I assume his best friend will say he has improvidently pounced on a matter which, for their interests, he had much better have let alone, and that his side-attempts to upset matters of fact constitute a miserable failure.

The following formula are produced, independently of all experiment, and are therefore either absolute truth, or positive error. They result from principles which I have before attempted to establish; and now, to prove their validity, they will be applied to a variety of experimental results, universally admitted to approach true temperature more closely than any others yet made, viz., the experiments by a commission of the Academy of Science in Paris, made at the instance of the French Government, and which are truly described by Mr. Scott Russell as the most imposing series of experiments hitherto conducted, and occupying a space of six years. Should I be so lucky as to succeed in the wild attempt described, at the cost of a few grains of ink and a sheet of white paper, whilst experimentalists of different nations have expended many thousands without having determined "the fixed relation between the temperature at which water boils and the elasticity of the steam which it produces—and notwithstanding the numerous experiments and investigations described by Dr. Dionysus Lardner, in his Cabinet Encyclopædia, (page 162, on heat,) all hitherto made having been unsuccessful—I entertain a hope that the following paper will take effect as a sedative against the fashionable folly of trusting to experiment to establish principles, instead of holding fast to soundly established reason, and testing it approximatively by experiment.

ON THE TEMPERATURE AND PRESSURE OF STEAM.

A scale of the temperature of steam has elsewhere been described under the circumstances, that, when it is produced from a given quantity of water, as one cubic inch, and when the pressure on the steam is increased in the same proportion as the volume is increased, the temperature of the volume is increased proportionally to the square of the space occupied by the steam, or to the square of its atomic temperature, the last expression signifying that indicated by an instrument, of which the scale represents *true* temperature; for if (v) be the volume at the pressure (p), the temperature of the volume will be $v\,p$, and at the pressure $(2\,p)$ the volume will become $(2\,v)$, and the temperature of the volume $4\,v\,p$, or as the square of the pressure.

Steam being generated from an indefinite quantity of water, the space it occupies being limited, as in the usual boiler of a steam-engine, the aforesaid law is reversed, for the volume being constant, the action of the fire is exerted solely in giving elastic pressure to the steam. Therefore the temperature of the steam is increased *inversely*, as the duplex of the square of the ratio in the first described case, or *directly*, as the square of the square, or fourth power of the pressure: whence, by inversion, as a general law, the pressure of the steam, when produced as in the usual boiler of a steam-engine, is increased proportionally to the fourth root of its temperature.

From which rationale, dividing the scale of temperature at the boiling or steam point of water, when under a pressure of one atmosphere, into 100 parts or degrees, to correspond with the centigrade, and the divisions being numerical representations of true temperature, the temperature at a pressure of (a) atmospheres is found by—

Formula 1. $(a)^{\frac{1}{4}} \times 100 =$ the degree of temperature of steam by the centigrade when under a pressure of (a) atmospheres.

Formula 2. $[(a)^{\frac{1}{4}} \times 180] \times 32 =$ ditto by Fahrenheit. Or the temperature as found by the centigrade ×*ed* 1.8, and added to 32, is the same in result as by this formula.

Example. Showing the pressure of steam by formula 2, under a pressure of 50 atmospheres, $(50^{\frac{1}{4}} \times 180) + 32 = 510.646$ F; and the temperature, as shown by the Academy of Science in Paris, at the same pressure, is 510·6° Fah.

The results of formula 1 will now be compared with 30 experiments by the same Academy, as they appear in a treatise "On the Nature, Properties, and Application of Steam, and on Steam Navigation, by John Scott Russell, M.A., F.R.S.E., &c.," at page 75, and which experiments are therein described as *most unexceptionable*.

In the following table, column 1 is the temperature by the smaller, and 2 is the same by the larger centigrade, when the pressure is the number of atmospheres in column 3. Column 4 is the temperature by formula 1, and column 5 is the difference between the experiments by the smaller centigrade and column 4.

TABLE I.

No. Expt.	1 Smaller Cent.	2 Larger Cent.	3 Atmospheres.	4 By Formula.	5 Difference.
1	122·97°	123·70°	2·14	120·90°	2·07°
2	132·58	132·82	2·87	130·15	2·43
3	132·64	133·30	2·88	130·28	2·36
4	137·70	138·30	3·348	135·26	2·44
5	149·54	149·70	4·584	146·32	3·22
6	151·87	151·90	4·86	148·47	3·40
7	153·64	153·70	5·12	150·42	3·22
8	163·00	163·40	6·51	159·73	3·27
9	168·40	168·50	7·391	164·58	3·52
10	169·57	169·40	7·613	166·13	3·44
11	171·88	172·34	8·114	168·77	3·11
12	180·71	180·70	9·895	177·43	3·28
13	183·70	183·70	10·60	180·43	3·27
14	186·80	187·10	11·48	184·07	2·73
15	188·30	188·50	11·66	184·78	3·52
16	193·70	193·70	13·19	190·37	3·13
17	198·55	198·50	14·53	195·24	3·31
18	202·00	201·75	15·65	198·89	3·11
19	203·40	204·17	16·21	200·65	2·75
20	206·17	206·10	17·13	203·44	2·73
21	206·40	206·80	17·23	203·74	2·66
22	207·09	207·40	17·30	203·94	3·15
23	208·45	208·90	18·05	206·12	2·33
24	209·10	209·13	18·16	206·43	2·67
25	210·47	210·50	18·55	207·53	2·94
26	215·07	215·30	20·44	212 62	2·45
27	217·23	217·50	21·31	214·85	2·38
28	218·30	218·40	21·60	215·58	2·72
29	220·40	220·80	22·66	218·17	2·23
30	223·88	224.15	23·994	221·28	2·60

The extreme differences of the formula and experiments are 2·07 and 3·52 degrees, to account for which it may be said, that, if the rationale on which the formula is founded, be admitted sound, the difference must be considered as an error of the instrument, or in its observation.

It is plain, one or other is defective, for otherwise, columns 1 and 2 would agree; but however unexceptionable the experiments may be held as experiments, they are not mathematically true, as columns 1 and 2 differ in the first experiment 0·75 +, and in the 23d, 0·45.—It is, therefore, rational to assume, that, had two manometers been employed to indicate the pressure instead of one, there would have been proportional differences as by the thermometers, and thus 1·5 degree may be taken, or at least supposed to have been accounted for, and which leaves a further difference of 2·02 degrees.

In the last number of this journal, it was shown that the thermometer, by the scale of Celsius, is liable to an extreme error in the ordinary method of its graduation of 1·7624 degrees, and of Fahrenheit, of 3·17232 degrees, but decreasing as the temperature surrounding the stem approaches to that of the bulb. Of such error I shall not avail myself, for want of data; but the point on which I shall rely is, the difficulty of maintaining an exactly uniform pressure of steam for such length of time that the entire contents of the bulb of the thermometer becomes of equal temperature, for, if otherwise, the scale will not show the true temperature of the steam. I can say, from experiment, that when the bulb of the thermometer is one inch in diameter, and the temperature increased at such rate that the mercury will rise one degree in 5 minutes, it will require 45 minutes before the entire mercury in the bulb is of uniform temperature.

The Academy did not allow that or any other time; nor was a correction made on the account now under consideration; but in order to reduce in part the error which would so arise, the heat was communicated "by adopting very slow variations of temperature." The rate is not given, nor the diameter of the bulb, so that the error cannot be computed; but if the temperature were increased six-tenths of a degree in 5 minutes, the error would be about 2 degrees, from which, those who take any interest in the advancement of science, may judge for themselves whether the differences of the experiments of the academy, and the results by the formula, have been rationally accounted for.

Experiments have also been made with great care, on a large scale, by the Franklin Institution of America; nevertheless, at 20 atmospheres of pressure, the difference between their experiments and those of the French Academy is 13·5° F., or nearly three atmospheres, being more than double the difference between the experiments of the latter and formula 2.

A great variety of empirical formulæ have been projected by the most eminent philosophers and mathematicians to connect the temperature with the corresponding pressure of steam; but as all these were made up without being based on any principle, and merely to agree with particular experiments, each consequently disagrees with the other. The last seems a modification of previously existing formulæ according to a mean curve, or series between the French and American experiments, proposed by Mr. Scott Russell, the results by which will be shown in the following table, containing the temperature by Fahrenheit at a pressure of 20 atmospheres each by the French Academy and Franklin Institution; column C being the result by formula 2, and R that by Mr. Russell's; and columns C R and R L are the differences between the formulæ and the experiments by the French Academy.

Table II.

Atmos.	French Ac.	Franklin Ins.	C.	R.	CR.	RL.
1	212° F.	212° F.	212° F.	212° F.	0 0	0·0
2	250·5	250·0	246·0	249·7	4·5	0·8
3	275·2	275·2	268·9	274·1	6·3	1·1
4	293·7	291·5	286·5	291·9	7·2	1·8
5	308·8	304·5	301·1	306·8	7·7	2·0
6	320·4	315·5	313·7	319·2	6·7	1·2
7	331·7	326·5	324·7	329·9	7·0	1·8
8	342·0	336·0	334·7	339·3	7·3	2·7
9	350·0	345·0	343·8	348·8	6·2	1·2
10	358·9	352·5	352·0	355·6	6·9	3·3
11	366·8	—	359·8	363·0	7·0	3·8
12	374·0	—	367·0	369·4	7·0	4·6
13	380·6	—	373·8	375·5	6·8	5·1
14	386·9	—	380·1	381·3	6·8	5·6
15	392·8	383·8	386·2	387·0	6·6	5·8
16	398·5	—	392·0	391·9	6·5	6·6
17	403·5	—	397·4	396·7	6·4	7·1
18	408·9	—	402·7	401·3	6·2	7·6
19	413·9	—	407·7	405·8	6·2	8·1
20	418·5	405·0	412·5	410·0	6·0	8·5

On the foregoing table, it will be observed that the error by Mr. Russel's formula is in an increasing ratio; whilst the differences by the formula now given would be nearly the same throughout, if the experiments were corrected. At a pressure of fifty atmospheres, the difference by Mr. Russell's formula is 19·2°, (*vide* p. 125), or about 7·6 atmospheres; by formula 2, it is only 0·046°, being 0·015 atmosphere of pressure.

It may now be submitted that the experiments, both of the Academy and Franklin Institution, notwithstanding the time and expenditure bestowed, are only to be considered as approximations towards the relative temperature and pressure of steam—that no law has been established therefrom—and that the same will hold good, even should the above rationale be considered invalid, and the formulæ, consequently, worthless.

The design of this paper is not to point out experimental discrepancies, which, within the ordinary range of practice, would be equivalent to nothing, but to provide engineers with a rationale by which they may exercise reason, even to the prejudice of their experiments, and thus escape practical errors of grievous magnitude, affecting the interests of a large portion of the public, and cramping the national energies and resources, both at sea and on land.

7, *Upper Penton Street, April* 5, 1849. John Curr.

Postscript.—Since the above was written, on examining the formula of the French Academy, I find that, on making two variations therein, the one infinitely small, and the other of vast magnitude, it will agree exactly with formula 1 above. Amongst the Commissioners of the Academy engaged in the matter are the names of the late Baron Prony, Arago, Girard, and Dulong, to differ with or correct whom may seem an act of presumption ill-becoming one whose mathematical knowledge is self-acquired.

Not to mislead the reader, I will quote from page 110 of Mr. Russell's work, as follows:—

"The French Academy of Sciences have finally reduced the index to 5, finding that number to represent their experiments at high temperatures. They adopted the following expression:—

"$F = (1 + 0·7153\,t)^{5}$ . . . . . . to give the elasticity in atmospheres of 0·76 metres, the temperature being in centessimal degrees, of course.

"$t = \frac{F^{\frac{1}{5}} - 1}{0·7153}$

"F being the elastic force due to a certain temperature, *t*."

On the following page is a collection of various formulæ by different philosophers. I read as follows:—

"Commission of the French Academy. $Ft. = (0·7153\,t + 1)^{5}$."

For the decimal 0·7153, I propose to substitute $\frac{50 \times ·76}{\frac{50^{1}}{5} \times 100} = 0·714518$ nearly. Then, instead of the index of the power being 5, I propose the equation to read thus:— $\frac{5\,F}{0·714518} = t$, which, at the pressure of 50 atmospheres, is $\frac{5 \times 50 \times 0·76}{0·714518} = 265·91479°$ by the centigrade, or 510·646° of Fahrenheit, agreeing exactly with formula 2 above, and differing from the result as shown by the Academy 0·046, or the forty-sixth thousand part of a degree only. The last equation inserted becomes $Ft. = \frac{0·714518\,t}{5}$ whereas, by the Academy, it is $Ft. = (0·7153\,t + 1)^{5}$, being an error of millions of millions.

Whether the error belongs to the Academy or Mr. Russell may be seen on reference to the tenth volume of the Memoirs of the Academy of Sciences, printed in 1831; but casting a glance over page 111 of Mr. Russell's treatise, wherein the different formulæ of different nations are collated, is enough to remove the doubt, unless they have copied each other, or acted in concert.

There is another grievous mistake—the formula is given as general, whereas it is only true in one particular case, viz. at the certain temperature *t*, and when *t* corresponds to a pressure of 50 atmospheres, the suppression of which reduces the value of the formula to nothing. To supply this deficiency, the decimal number, at F atmospheres of pressure, in mitres, is $\frac{F \times 0·76}{F^{\frac{1}{4}} \times 100°}$ = the co-efficient of *t* in a general formula, when F is the numerical pressure in atmospheres; for example, $F = \left(\frac{F \times 076}{F^{\frac{1}{4}} \times 100}\right) t$.

The actual experiments by the French Academy are said to have been carried to the extent of only 24 atmospheres; consequently, the temperature at 50 atmospheres has been computed; and its coincidence with my formulæ is ample proof, if such be requisite, of the validity of the rationale proposed above.

It is not readily to be conceived how any such like weighty matter should have been marred in the manner shown, and for the corrections of which I feel responsible, if I have in any manner mistaken the case; but whether so or not, it is rather a specimen of daily occurrence, in such cases, than the exception; and although the coincidence between my formula and the Academy is almost perfect, at 50 atmospheres, it neither adds to, nor detracts from, my assurance in the soundness of the rationale, which was the produce rather of intense reasoning, which it would be difficult to communicate in clear terms to others, than of pure mathematical demonstration. Nevertheless, the coincidence may help to give confidence to those who neither rely on their own reasoning powers, nor waste time in sifting any such like stale cases to their foundation.

It now remains for philosophers and mathematicians to examine and determine amongst themselves whether, independently of experiment, a law rigidly connecting the elastic pressure with the (true) temperature of steam has been determined; and if so, they will at once perceive its utility in constructing a thermometer, with a scale of true temperature, universally applicable to every purpose, and by which the measure of temperature throughout the world will be the same.

RAILWAY SIGNALLING.

In the 11th number of your Journal, I find an article under the above very common title, describing an apparatus for signalling between the guard of a railway train and the engine-driver. This apparatus seems to me to be rather costly and complicated, and little likely to be generally adopted. On reading your correspondent's description, it immediately occurred to me, that by a very simple arrangement, which might be applied to any engine in about five minutes, the steam-whistle attached to the engine might be made to answer as effectually as the most complex mechanism.

On perusing your last number, I find that your correspondent, Mr. Passavant, is of the same opinion with myself, and has, moreover, had a contrivance of this kind in operation. This gentleman's arrangement, it appears to me, is still rather deficient in simplicity. The bell-crank connection, proposed by him, is not only unnecessary, but I should say, liable to derangement, as any alteration in the relative positions of the engine and tender would hinder their proper action, and, in some cases, entirely prevent it. What I propose is, simply to attach a strong cord to a lever fixed on the stop-cock of the steam-whistle. This lever must be of sufficient length to carry the cord over the head of the driver. All that is now required is, to stretch the cord over the roofs of the carriages forming the train, to the last of which it is to be attached. In the event of the couplings of any of the carriages giving way, the strain upon the cord will open the whistle; but to render it self-acting in the other cases, for which Mr. Passavant proposes rods and chains passing under the foot-boards, it is necessary to pass the cord through metallic eyes fastened to any convenient part of the carriages, there being one on each. The breaking of an axle, or a carriage getting off the rails, will, by this arrangement, cause a strain upon the cord sufficient to sound the whistle. In place of the metallic eyes, hooks fitted with springs, of the same construction as those now in use for coupling the carriages, might be found to save trouble.

I would recommend that the lever on the stopcock, when not in action, be inclined slightly towards the front of the engine, with a check to prevent its falling altogether. In this way it is retained in its proper position, till pulled in the opposite direction by the cord. A very slight strain upon the cord is sufficient to open the whistle; for no sooner has the lever passed the perpendicular than it falls in the opposite direction, till stopped by another check, and will remain so, allowing the whistle to sound, till returned to its proper place by the engine-driver, thereby intimating to the guard that the signal is attended to. To prevent any damage which might be occasioned by an extra strain upon the cord, as in the case of the carriages becoming disconnected, its fastening at the end of the train must be of such a nature as to give way. For instance, a spring might be used, which, in yielding, would allow the cord to slip off; or perhaps a better plan would be, to have some such arrangement on the lever, as it would save having an attachment of this kind on each carriage.

Simplicity is a point of very great importance, and should be aimed at in all mechanical contrivances. This is not sufficiently attended to, perhaps from a mistaken notion, that simplicity detracts from the merit of an invention. If you think I have not here run counter to my professions, perhaps you will be kind enough to allow this a small space in your Journal.

H. R.

THERMOMETRIC OBSERVATIONS.

Perhaps I ought not to trespass further on your patience and space, by any more replies to Mr. Curr's extraordinary communications under the title "Thermometrical Observations." If the present be admitted, I promise it shall be the last. Every successive letter brings Mr. Curr's incompetence to deal with the subject he has undertaken to discuss into broader light, and exhibits an ignorance more hopelessly impenetrable. His last communication, like its predecessor, is replete with crudities and error. It would be mere waste of time and paper to point them out. I shall state one only, lest he should suppose I speak thus in general terms without a basis of detail to rest on.

We have not far to go for a specimen of his "acknowledged small attainments." His opening paragraph offers melancholy proof of his inability to deal with anything mathematical. When I speak of "suppressing the circular multiplier," he seems to associate the "suppression" with culpable concealment; at all events, the "suppression" carries an error in its train, according to Mr. Curr's logic. If I had known the measure of his "attainments," I should have explained that the phrase is equivalent to "dividing all the terms by a factor common to the whole." The doctrine which the gentleman quarrels with, he will find very perspicuously stated in the fourth axiom of the fifth book of Euclid, and most people believe it.

When Mr. Curr calls his attainments "small," his modesty wrongs him sorely, if, as he asserts, he has established the proportionality of heterogeneous quantities. The luminary now about to burst on us will "pale the ineffectual fires" of all philosophers, past and present, and the highest niche in the Temple of Fame will be readily accorded to the discoverer of this new doctrine. This is the proper ground on which to rest his claims to distinction. His thermometrical achievements are thoroughly eclipsed in its superior splendours.

I am sure, Mr. Editor, you will excuse my pardonable vanity, if I express a hope that a few preliminary blasts of Fame's trumpet, in making the great announcement, will herald forth the subscribed initials as having been instrumental in pointing the way to this rich scientific mine. It is true I play but a subordinate part—second fiddle—and I meekly admit that it is very second; nevertheless it is much to be associated with such a sublime discovery at all: and that my priority of claim in this respect may be the more sure, I shall propose the first problem for solution by the new theory. I used sometimes to hear it propounded at school, but it transcended the powers of all the logic we learned there—

> Such as the musty, fusty, worn-out rules
> Of Locke and Bacon—antiquated fools;
> But then the key, if such a key there *wur*,
> Was undiscovered yet by Mister Curr.

I conclude by stating the problem, rejoicing that the means of solution have been at length attained. It is this:—If a pound of butter cost thirteen-pence, what is the price of a load of potatoes?

H. R.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF MECHANICAL ENGINEERS.

(Concluded from page 20.)

In the absence of the inventor, the Secretary explained Mr. Baines' Improved Railway Chairs and Switches. The first portion of this invention is an improved joint chair, the object of which is to prevent the joints from rising or getting out of line, and the rails from driving forward. The outer jaw of the chair, as shown in the accompanying specimen, fits close up to the under side of the head of the rails, but the inner jaw is only of sufficient height to clip the bottom flanch of the rail; and the rail is not fixed by a key, but by a square wrought-iron dowel-pin, which is passed through a hole in the outer jaw of the chair, and a corresponding notch in the end of each rail. This dowel-pin is $1\frac{3}{4}$ inch wide and $\frac{7}{8}$ inch thick, and has a large flat head, and under the head is placed a wrought-iron plate, 9 inches long, which fits close up to the head of the rails on the inner side, and rests on the chair. A square cotter is then driven vertically through the outer end of the dowel-pin, which draws the whole firmly up to the outer jaw of the chair; the wrought-iron plate is $\frac{3}{4}$ inch thick in the middle, tapered to the ends, and slightly cambered, and it is sprung flat by driving the cotter. The cotter is made long enough to drive through the bottom of the chair into the sleeper, and serve as the spike on the outer side of the chair; a slot is made in the upper part of it to allow of the cotter being drawn out when required, by inserting a lever in this slot. Two ordinary spikes are driven on the inner side of the chair.

The notches in the rail ends are made by a revolving cutter, which is shown in an accompanying drawing; the rail is laid in a cast-iron bed in the machine, and the cutter is made to a fixed guage, so that all the notches in the rail ends correspond exactly in size and position, and there is no difficulty in keying up the dowel-pin. This is made to fill the hole in the outer jaw of the chair, but only fits the bottom and one end of the notch in the rails, to prevent any weight coming on to it; and it does not interfere with the ordinary allowance for expansion between the rails. The cutting machine is in a portable form to be worked by hand, and the notches in the rail ends can be readily and quickly cut on the ground, with the same accuracy as those made in the manufacture of the rails.

The pressure of the wheels has no tendency to loosen the fixing of the rails in this chair, as it is all resisted by the chair, the outer jaw of which fits close to the head of the rails, and the bottom flanch of the rails is firmly clipped by the inner jaw of the chair. The dowel-pin does not receive any of the pressure of the wheels, but holds the rails firmly against the outer jaw of the chair, and prevents any risk of a foul joint occurring.

The dowel-pin also prevents the rails from rising at the joint, and from driving forwards; and the latter is an important advantage both for safety and economy, as the action of the trains running is continually driving the rails forward to so great an extent as to cause a considerable item in the expense of keeping the line in repair, to prevent the rail ends being driven out of the joint chairs, which would cause a serious accident. In the ordinary construction, there is nothing but the friction of the wood keys to resist the driving of the rails; and the effect of the weather on the wood keys, alternately shrinking and swelling them, causes their hold on the rails to be gradually weakened.

The long plate under the head of the dowel-pin fits close up to the head of the rails, and being drawn up tight against them, serve as a scarfing piece to connect the two rail ends stiffly together, and prevent the working of the joint. This effect is shewn in the two accompanying models of five lengths of rail connected together by these improved joint chairs, and five corresponding rails connected by the ordinary chairs with wooden keys; the first is stiffly coupled together like one piece of rail, but the other is weak and loose at the joints.

The stiffness of the joint causes one rail end to support the other, and prevents the working of the joint, and the canting of the joint sleeper during the passage of every train; which is so serious an evil in the ordinary construction of permanent way, causing a shock at every joint from each wheel that passes over it, which weakens the tenacity of the iron, and makes the rails break at a short distance beyond the joint. This increases the smoothness of the road for travelling, as well as the safety, and diminishes the expense of maintenance of the permanent way. The elasticity of the long plate allows of the joint being sprung, as much as is required for slewing the road in laying or repairing.

The next portion of this invention is an improved intermediate chair, the object of which is to fix the rail without the use of any key. The two jaws of the chair are made exactly alike, and are set obliquely instead of opposite to each other, as shown by the accompanying specimen and drawing. The chair is slipped endwise on the rail, and then twisted at right angles to the rail, which makes it grip the rail between the two oblique jaws; and the chair is forced tight against the rail on each side, and made to hold it firmly by means of the spikes. These are screws with long conical heads, and the holes in the chair are made with an irregular countersink, which is oval and eccentric at the bottom; so that when the spike is screwed into the sleeper close to one side of the hole in the chair, and the conical head is drawn home into the countersink, the chair is forced gradually round, and increases the pressure of the jaws on the rail. These holes for the spike-heads are made with ½ inch draught, and the oblique position of the jaws, as shown by the accompanying drawing, gives a leverage of three to one to increase the pressure on the rail. The jaws of the chair fit close up to the head of the rail, so as to hold it very steady and firm; but the yielding of the spikes in the wood-sleeper allows some elasticity to prevent the road being too rigid. To ensure these chairs being all made correctly to fit the rail, it is proposed to cast them from a metal pattern, a specimen of which is exhibited with the chair.

This chair prevents the rail working loose, as there is no wood key to get slack or lost out, and the spikes are screwed into the sleeper; also the constant serious expense of renewing the keys is avoided, and the expense caused by the great number of chairs broken in driving the keys, which will form an important improvement in economy and safety.

The only trial yet made of these improved joint and intermediate chairs has been at Norwich Station, where a short length in the main line has been laid with them for a few months, which has proved quite satisfactory.

The last part of the present invention is an improvement in switches, which consists principally in making the tongue of the switch about an inch deeper than the main rail, so that the bottom flanch of the tongue works under the main rail. The bottom flanch is kept entire to the end of the tongue without being cut, which adds materially to the stiffness and steadiness of the switch tongue, by giving it a broader base to slide upon. Another object of this construction is to make the switch clean itself in working, by driving the dirt under the main rail, instead of against it, as in the old construction, where the tongue and the main rail, being of the same depth, the dirt gets pressed between them whenever the switch is worked and cannot escape, which is a great source of accident, by preventing the tongue from shutting close, and causing it to catch the flanch of the wheels. This is further provided for by the form of the seats of the switch chairs, which are made with a raised face in a diagonal direction for the tongue to slide upon, and sloped off on all sides, by means of which the working of the tongue continually clears the dirt off the face of the chairs.

This switch is capable of being laid either right or left-handed, without giving up the advantage of having the long tongue to lead, because the two tongues are shaped exactly the same on both sides, as the bottom flanch is not cut, and they will fit on either side; the only difference in changing from right-handed to left-handed being, that a slight bend of the tongue is required, which is done by the plate-layer in laying the switch. The point of the tongue is prevented from rising when a train passes over, by the bottom flanch of the tongue locking itself under the main rail.

The lever box shown in the model of the switch is made to prevent the entrance of dirt, which accumulates in the present boxes on account of the large opening left in the cover for the lever to work through. In this improved lever box, the lever and connecting rod are both attached at the side of the box to the end of a shaft which passes through a hole in the side of the box, and is connected to the weight inside by a segment; a cover fits closely over the top, so that no dirt can get into the box, as the shaft fills the hole in the side.

The connecting rod between the switch tongues is split at the ends with a notch at each side, and the end of the rod is nipped close to put it through the hole in the tongue, and then springs open and holds the tongue firmly by the notch at each side; the split end is kept open by a vertical split-cottar, and this construction is less liable to get disconnected by accident than the usual connecting rods with screwed ends.

The consideration of the practical value of these improvements was adjourned to the next meeting of the Institution.

INSTITUTION OF CIVIL ENGINEERS.

Tuesday, March 27, 1849.

William Cubitt, Esq., Vice-President, in the Chair.

The paper read, was a "Description of the Groynes formed on the South Rocks, the site of the new docks at Sunderland," by Mr. W. Browne, Assoc. Inst. C. E. These groynes have been erected for the purpose of retaining the deposited materials excavated from the new docks, and of arresting the sand and shingle which naturally travel southward, in order to form a barrier beach, that should effectually exclude the sea from beyond a given line. The three first, whose lengths varied from 326 feet to 358 feet, were erected at a height above ordinary high-water mark of 2 feet 6 inches, and 10 feet at the seaward and inner ends respectively. The exterior was composed of ashlar work; the interior partly of the excavated magnesian limestone, and partly of rubble set in mortar; the batter of the north sides was two and a half inches to a foot, that of the south sides one to one, and the crest was formed into an arch, with a radius of 5 feet 6 inches. The four other groynes were constructed of a different form, in consequence of those first erected not retaining the deposited excavation, and accumulating other materials as was desirable, and from their having been injured by the sea during a heavy storm, which occurred at the time of the equinoctial tides during the spring of 1848, when a breach was made in the first and third groynes, and at the same time some of the stones in the second groyne were loosened; these effects were produced at about the same point in each, namely, the intersection of the inclination of the groyne with the line of ordinary high-water mark; and it was found from observation, that the momentum of the waves was greatest at or about the time of high water. The sides of these groynes were semi-cycloidal, each being generated by a circle of 12 feet 9 inches in diameter, and uniting at the apex; the seaward and inner ends are respectively 7 feet and 10 feet above ordinary high-water mark, and their lengths varied from 510 feet to 579 feet; the foundations of these groynes consisted of a course of freestone, laid at an average depth of 2 feet below the surface; the sides were also of coursed freestone, set header and stretcher alternately, and the hearting of large-sized rubble closely packed, the vacancies between it and the ashlar work being filled with small stones set in Roman cement, so as to ensure a solid bed; at a depth of 6 feet below the crest of the groyne, and resting upon the rubble hearting, coursed ashlar was introduced, and carried as near to the crest as possible, the vacancy being filled with small rubble and Roman cement. The construction of these groynes commenced at the seaward point, and they were placed at distances of from 350 to 450 feet apart; the quantity of material excavated and deposited between them was stated to amount already to 730,000 cubic yards; it consisted partly of hard blue clay, and partly of marly rock, or soft magnesian limestone, and the barrier beach formed by them had completely withstood all the gales which occurred during the winters of 1847-8, and 1848-9.

Some very interesting information was given as to the action of the tides in the Wear, and the reasons for the construction of the new docks, which were stated to promise to be of immense importance to the trade of that port.

During the discussion, Mr. Murray explained very clearly his views in the design for the docks, and for the direction of the groynes, and the various works in the harbour for arresting the waves in their progress up the river. This investigation of this subject elicited some very interesting remarks as to the action of waves striking walls and groynes at various angles, when, instead of being entirely reflected, they were in part retained and guided along the face. This was a peculiarity which, it was stated, should be taken advantage of in hydraulic works.

ROYAL SCOTTISH SOCIETY OF ARTS.

Monday, March 12, 1849.

George Lees, A.M., Vice-President, in the Chair.

On the Warming and Ventilation of Dwelling-houses. By Captain John H. Hall. An illustrative drawing was exhibited.

A communication on the economical warming and ventilation of dwelling-houses, consisting, first, of general observations on the inefficiency and wasteful character of the existing method of warming houses, by means independent of open fires in the several rooms; and, secondly, describing certain arrangements for insuring an uninterrupted supply of warmed fresh air to any one or more, at pleasure, of the several apartments of a house, by the use of one stove or warming apparatus.

Description of a Tubular Railway Bridge of a new construction. By Daniel Miller, Esq., C.E., 186 St. George's Road, Glasgow. A large drawing to scale was exhibited.

In this design it is intended to form a construction of malleable and cast iron, so as to apply their respective properties in the most advantageous manner to resist the opposing strains of tension and compression, which are brought into action in a structure of this nature. The drawing represents a design, on this principle, for a railway bridge to cross the Clyde at Glasgow harbour, in two spans of 200 feet each. Each span consists of three girders, each 18 feet deep, which divide the bridge into two lines of rails. The upper part of each girder is formed of a circular tube of cast-iron, 2 feet 9 inches diameter, which is of the best form and material for resisting compression. The upper side of the tube is thicker than the lower, as the inner circumference is eccentric to the outer. The lower part of the girder consists of a rectangular tube, 3 feet deep by 2 feet 9 inches broad, formed of plates of malleable iron chain, rivetted and strengthened at the corners by angle iron. This is considered the best form for resisting the tensile strain, and preserving the necessary rigidity. These two tubes, forming the upper and lower sides of the girder, are united by frames of toughened cast-iron, which are cast of an open trussed form, so as to secure lightness and strength. At intervals of 15 feet, brackets are attached on each side of the centre of these frames, from the extremities of which, proceed wrought-iron rods to the top and bottom, for the purpose of increasing the lateral strength and rigidity of the frames. The girders are united to each other transversely, both at top and bottom, by an arrangement of braces and struts of wrought and cast-iron. All the cast-iron in the structure is proposed to be of Mr. Stirling's toughened cast-iron, which, by the recent Government experiments, is proved to possess remarkable advantages in elastic resistance, and in resisting compression and tension; and removes the objection hitherto prevailing against employing cast-iron for railway bridges of large span, or where exposed to vibratory action.

The author considers that this combination of malleable and toughened cast-iron will fulfil the principal conditions required in such a structure, in economy, rigidity, elastic resistance, and ornamental appearance.

Description of a Drawing of an Improved Railway Turn-Out. By Mr. John Charles Pearce, Hulme Street, Salford, Manchester.

On a new Electro-Magnetic Coil-Machine. By Dr. Thomas Wright, F.R.C.P., 37 Queen Street. The Machine was exhibited in action, with Dr. Wright's new Battery.

Dr. Wright stated that his machine consists of a bundle of thin iron wires, seven inches long by six-tenths of an inch in diameter, wound with thirty yards of No. 16 copper wire. It is fixed by half its length in a frame of wood, the other half being free, to permit a thick brass tube to slide over it. It is furnished with a self-acting adjustment for interrupting contact with the battery, an account of which was published by the author in Sturgeon's Annals of Electricity for March, 1840, and which is, the author believes, used in all electro-magnetic coil-machines.

The great power of this instrument was stated to depend upon the accuracy of the construction of the electro-magnet. A great number of experiments were instituted by Dr. Wright, for the purpose of determining the proportion to be observed between the coil-wire, the iron to be magnetized, and the battery. This differs with the kind of battery used; but, for general purposes, the arrangement above described appears to be the best. Dr. Wright stated that it is most essential that the coil-wire be brought as close as possible to the iron; and that to effect this, the coil-wire is simply insulated by a single layer of the thinnest tissue paper, instead of the coverings of worsted or cotton which are generally used. Dr. Wright stated, that an instrument thus constructed, besides giving a succession of powerful shocks, possesses an extraordinary power of effecting chemical decomposition: the electro-magnetic machines he had hitherto seen scarcely affording more than a few bubbles of gas, when employed in the decomposition of water, while Dr. Wright's machine gives a torrent from the electrodes of the voltameter. Dr. Wright stated that a most powerful machine may be packed in a box, 8 inches by 2½, which can be carried conveniently in the hand. In medical practice, Dr. Wright found that the still smaller machine, which he exhibited, is more than sufficiently powerful, though its size is only 3½ by 1½ inches.

A motion by the Secretary, for the discharge of the Committee on Mr. R. Burn's Steam-Power Roller-Gin, was agreed to, the invention having been patented.

March 26, 1849.

John Cay, Esq., F.R.S.E., President, in the Chair.

Description of several new and simple Stereoscopes, for exhibiting, as Solids, one or more representations of them on a Plane. By Sir David Brewster.

This paper contained the description of a particular stereoscope, constructed with two semi-lenses, or two quadrants of a lens, united as spectacles, but in such a manner as to give double images of objects, or of drawings of solids, as seen by each eye separately. When two of the images thus produced were united, as in the instrument, the solid, either raised or hollow, from which the drawings were taken, was reproduced. Another stereoscope, called the Total Reflection Stereoscope, was described, which required only one drawing of the solid, the other drawing being created by the instrument, and united with the picture seen by the other eye. Single and double reflecting stereoscopes, of great simplicity and easily constructed, were also described; together with microscopic stereoscopes, which can be carried in the pocket.

The thanks of the Society were voted to Sir David for this communication.

The Obstetric Air Tractor, invented by Professor Simpson, F.R.S.E., was exhibited by Mr. Archibald Young, instrument-maker, 79 Princes Street

This instrument, intended to supersede the forceps, is constructed on the principle of the sucker, being a hemisphere of vulcanized india-rubber, with an air-pump attached, for exhausting it; and, on being applied, enables the operator to exert any requisite force, from 1 to 50 lb.

It was stated that this invention had been recently and successfully applied.

Description of a Time-Signal for Railways, Steam-Boats, &c. By James S. Torrop, Esq., 28 London Street, Edinburgh. A working Model was exhibited.

The present instrument has been devised to meet a great want, which has long been felt, for some certain and effective means of informing or warning the public of the approach and departure of passenger trains. Bells, rung within or near the station, cannot answer the purpose, the sound being easily stifled, and apt to be regarded, when loud enough to be heard at any distance, as a nuisance. Clocks are still more useless, as they are visible only at short distances, even when they can be placed on conspicuous positions.

This time-signal, or railway train's monitor, consists of a moveable ball, mounted on a lofty pillar, wound up to the top by clock work, and taking a definite time to descend. For railways, this time is set to ten minutes. When the ball is seen at the top of the pole or pillar, passengers approaching the station are informed that they have ten minutes; if half-way down, five minutes, and so on.

Being capable of being made a most conspicuous object, its indications can be distinguished at a considerable distance by intending passengers, who are thereby saved all unnecessary excitement and uncertainty in making their way to the station; while the officials are also saved from the annoyance of questioning as to the time the train is due.

Notice of a peculiar Property of Gutta Percha. By the same.

Gutta Percha, when cast and rolled into sheets, assumes a property belonging to fibrous substances; it acquires tenacity in a determinate direction. When in the roll or sheet, this tenacity is longitudinal; but if a strip be cut from the breadth, two peculiarities occur—the strip is susceptible of a definite elongation to nearly five times the original length, and its direction of tenacity is reversed. When it is considered that Gutta Percha is originally a fluid substance, or gum, these peculiarities are curious and remarkable.

Description and Drawing of a Rapid Filter, adapted for the perfect Filtration of Water for the supply of Towns, or for any other purpose where a large quantity of pure water is required. By Messrs. T. & W. Stirling, Bow-Bridge Slate-Works, Stratford, Essex.

The objects and advantages of this apparatus were stated to be—1st, While it is capable of being so combined as to filter large quantities of water, it also acts upon each gallon that passes, with the same minuteness and delicacy as the chemist employs for his most careful operations; 2d, It is made of a material upon which water has no decomposing effect; 3d, While it may be readily cleaned, it is in no degree liable to get out of order; 4th, It occupies but a small space compared with the quantity of water filtered by it; and, 5th, It is so arranged as to be guarded from the disturbing effects of frost or rain, and protected from soot, smoke, and dust.

A series of slate boxes or cisterns, the size and number of which are regulated by the quantity of water required to be filtered, as shown in the drawing submitted to the Society, are so placed that the reservoir or pipe from which they are supplied shall have a head of water of about two feet six inches. The water passing along the main pipe enters each filter at the bottom, through a branch pipe, and passes through three strata of filtering medium, (the lowest of which rests upon a hollow basis, across which a fine wire gauze is stretched,) through which it rises to the top of the filter in a perfectly pure state. The filtered water then passes from the top of each filter, through a small pipe, into a slate channel, along which it runs into the pipe, reservoir, or other receptacle for the filtered water. The filtering medium consists of three strata of incorrodible mineral substances; and the chamber in which they are placed admits the introduction of a hair-brush, such as is used for cleaning bottles; and with this the bottom of the filter-bed is readily cleaned of all residuum in a few minutes. The apparatus can be adapted to filter any quantity of water from 500 to 50,000,000 gallons, and may be applied, not only to domestic use, but to the purposes of papermakers, brewers, distillers, chemists, bleachers, wool-staplers, printers, and other trades for which large quantities of pure water are indispensable. The usual method of filtering water supplied to towns is by means of reservoirs of subsidence, and filter-beds, which occupy a large space of ground, and, at best, effect the object very imperfectly. This apparatus, however, can be so managed as to occupy only about one-twentieth part of the space required by the other methods now in use, and may be enclosed in a covered building, so as to protect it from rain, soot, and dust, and, when necessary, warmed by flues, to prevent the action of the filters from being impeded during severe frost.

Notice on the Ventilation of Public Buildings and Private Dwellings, with peculiar reference to the method adopted by him in the New Police-Office, Edinburgh. By R. Ritchie, Esq., C.E.

Mr. Ritchie brought under the notice of the Society the method of ventilation he had carried into effect at the New Police Buildings, Edinburgh, the plan being founded upon the principle for which, in 1847, this Society had awarded to him a silver medal and plate, value ten sovereigns.

He stated that the certainty of operation of this process, and its efficiency, had now been fully attested. He described that a furnace, placed at the basement of the building, was made to heat, with the utmost simplicity, a very powerful patent hot-water apparatus, placed seventy feet above it, at the roof, for extracting the foul air. The various rooms and cells in the building were each provided with a conduit to carry off the exhaled air; and these conduits terminated in a long gallery under the roof; the extracting apparatus was erected at one part of the gallery, at the bottom of an ascending shaft. This shaft terminated in a louvre, so arranged that the orifices of discharge could be regulated (according to the direction of the wind) in the furnace-room at the basement. By means of this powerful apparatus, the exhaled air drawn from the rooms and cells into the gallery, passed without obstruction into the atmosphere. He pointed out that this plan of ventilation possessed the obvious advantage, that it was free from the risk of the reflux of foul air and vapours of combustion into the rooms and cells; and it is likewise free from danger of fire.

Mr. Ritchie stated that this mode of ventilation could easily be adapted for one or for many apartments; and he considered it applicable to mining ventilation. The consumption of fuel for the ventilating apparatus at the police buildings was exceedingly small for the effect produced. He also described the means provided for supplying fresh air for renovation, which, in winter, was warmed by means of a mild hot-water apparatus, and the air regulated in moisture in a chamber of preparation. He stated that this method had been applied most successfully by him at various buildings, and referred, amongst others, to St. John's Chapel, Princes Street, which was equally heated with one fire, substituted in place of two stoves formerly used. The success of this plan was attested by the Chairman. He also made some suggestions as to the great advantages which would arise, were systematic arrangements for ventilation incorporated with the construction of buildings generally; and he mentioned various modes for making the conduits for exhaled air.

THE SOCIETY OF ARTS.

Session 95.

February 7, 1849.

"On Improvements in Electric Telegraphs, and New Plans for Printing by Electricity," by Mr. E. Highton, C.E., read at the meeting.

The author having, in the first part of the paper, directed the attention of the Society to the instruments, and the modifications and improvements which he had proposed for adoption, now proceeded to call attention to the batteries usually employed for telegraphic purposes, which are composed of zinc, copper, and dilute sulphuric acid. The cells ordinarily used on the lines of telegraphs in England are wooden boxes, divided into compartments by slate or porcelain; the inside of the cells being covered with marine glue.

As a substitute for this description of cells, Mr. Highton proposes to use, and exhibited cells made of, green bottle-glass. These can be made at a small cost—are perfectly indestructible, and good non-conductors. The best battery which the author has hitherto met with, is that in which zinc and copper, with a solution of the salts of ammonia, are used. Batteries of this description give a constant equable current, which lasts for months.

Having detailed a series of experiments with batteries of various kinds, the author next proceeded to show, that the electric power requisite for working a telegraph may be generated by means of the heat from a wax taper; but the experiments upon which he is at present engaged being incomplete, a more detailed account of them will be given in a future paper. He, however, anticipates being able eventually to work the telegraph by electric power generated by a gas-light, in lieu of the battery, the power being given by the unequal expansion of two kinds of metals, which, being fastened together and unequally heated, cause a straining of the particles, and a constant flow of electric power.

The next point to which Mr. Highton directed the attention of the Society was the line wires. The plan which Mr. Highton adopts for the insulation of the line wires, is to pass the wire through the centre of the post, having first bored a hole, and placed a small piece of stoneware in the hole, to prevent the wire coming in contact with the wood. By this arrangement he offers less surface for the lodgment of wet, snow, or other bodies, and reduces the liability of the electric current being carried off where the length over which the current has to be transmitted is very great. In addition to the above, he insulates the wire with a covering of gutta percha, or silk dipped in shellac varnish, for the length of a foot or two on each side of the post, and places a ferrule, or tag, on the wire where it rests on the insulator, so as to prevent the covering being chafed or cut by friction. Having thus detailed his mode of insulation, he next proceeded to give the following mathematical expression of the law which guides all the operations of the transmission of the electric current:—

$$F = \frac{nE}{\frac{nDR}{S} + \frac{lr}{s}}$$

Where
E = electromotive force,
n = number of plates,
D = distance of plates,
R = specific resistance of fluid,
S = area of plates,
l = length of circuit,
s = section of wire,
r = specific resistance of wires.

By this it was shown that the principal parts which, by increasing, tend to augment the current, are—

1. The electromotive force due to the metals employed;
2. The number of plates used;
3. The area of plates;
4. The section of the line wire.

And those parts which tend to retard the action of the current are—

1. The distance that the plates in the battery are apart;
2. The specific resistance of the fluid in the battery;
3. The length of the circuits;
4. The specific resistance of the wire.

The author observed, that all these are things which must be attended to in carrying out a system of electric telegraphs, if economy and certainty of action are the ends desired.

From this formula it was shown that a battery so small that it would even pass through the eye of a needle would stop the currents from another battery, however large the plates used were, provided that the liquid used and the relative electromotive force of the metals employed were the same.

Having given the above formula as illustrative of the laws which guide the transmission of electricity, and also exhibited an instrument by which the amount of leakage in the transmission of the current along the line may be ascertained, the author proceeded with the last part of his paper, viz. the action of natural displays of electrical power in the form of lightning and the aurora borealis.

Having alluded to the experiments of Dr. Franklin, and the manner in which he drew the lightning from the clouds, the author stated that he proposes to make a series of experiments, with a view of subjecting various substances to the direct action of lightning, in order to obtain further knowledge of the power of electricity.

This experiment he proposes to try by means of rockets made for the purpose, and containing a large portion of sulphur. By means of the sulphurous and sulphuric acid formed by the burning of the rockets, and the line of the vapour of carbon set free as the rocket ascends, he hopes to be able to open a channel for the lightning. The rocket he proposes to fire by means of a secondary current set free by the Perænode.

He next described the effect of lightning observed on the telegraph wires in the Kilsby Tunnel, on the London and North-Western Railway, during a violent thunder-storm in 1848; and also the peculiar effects of a magnetic disturbance, as observed on the 24th of September, 1847. On this occasion the magnetic needles of the telegraphs on the Peterborough Branch of the London and North-Western Railway were for a considerable time deflected from a state of rest, first on one side and then on the other. Other instances, in which the telegraph instruments havs been affected by lightning, aurora borealis, and fogs, were noticed, and varioue experiments in illustration were exhibited.

The author concluded his paper with a general retrospect of the whole subject.

February 14, 1849.

"On Specimens of Gold from various parts of the world, including some from California," by Professor Tennant, F.G.S.

Mr. Tennant commenced by observing, that the circumstances and general character of California correspond with those of the Brazils, Siberia, and other gold-washing districts. From an analysis by Mr. Henry of the gold ore from California, he had ascertained, that for every 100 parts the following proportions of metals, &c., had been obtained, viz:—

Gold	88.75 parts.	Copper	0.85 parts.
Silver	8.88 "	Silica	1.45 "

His object in bringing this subject before the Society was not that of holding out inducements for persons to emigrate to California or other colonies, although he did not doubt that gold had been found in the manner and quantities stated, as it had also in other countries; but he did doubt it continuing to be so found, and was therefore desirous of giving a few simple instructions as to the best modes of testing the quality of the ores found, and also of directing the attention of emigrants to the search for such other mineral substances as are most likely to be found with the gold.

The existence of gold in California had long been known, it having been discovered by Sir Francis Drake; other substances had also been found there, such as mica, the same glittering substance which is found in granite; iron pyrites had also been found, which latter much resembles gold in colour; and he had known instances in which large quantities of this substance had been sent to England by persons who had supposed it to be gold; but finding their mistake, they had probably abandoned their adventure, and returned to England greatly disappointed.

Gold has been found in most new countries, as Borneo, India; and he had found it himself on the Grampian Hills in Scotland (specimens of the same were exhibited); but the cost of freeing the gold from the ore was too great to render it worth the trouble of obtaining. Gold has also been found in Wales, in sulphuret of zinc; and in Cornwall, among tin.

Several specimens of various kinds of gold were exhibited, viz.—1. Foliated gold with quartz, from Mexico. 2. Crystallized gold. 3. A round peeble, weighing 9 oz. 14 dwts., containing over 6 oz. of gold (both these, from Brazil, had formed part of the Stowe collection). 4. Gold from Cornwall. 5. Gold in sulphuret of zinc, from the Hwnyswn mine in Merionethshire; besides several specimens of granular gold from the west coast of South America, Africa, and California.

In Brazil, according to Mawe, eight men had, in four hours, obtained twenty ounces of gold from a portion of soil not two tons in weight, taken from a deep hole at the bottom of the river. He should not be surprised to hear that diamonds, rubies, emeralds, sapphires, and other precious stones, were to be found intermixed with the gold; and to this, should there be any adventurous parties at present in the Institution who thought of going to California, he wished particularly to draw their attention, lest, while they were seeking for gold, more valuable substances might be overlooked. The average value of gold was about £3 15s. per ounce, that of diamonds, in their rough state, was about £50; while, if free from defects, flaws, &c., they were of greater value. He had, therefore, taken Jeffries' estimated value of pure diamonds when manufactured for jewellery purposes, as it is generally considered the best. Diamonds were in general weighed by the carat, which was a term well known to jewellers, and equivalent to 4 grs. Thus a diamond of—

1	carat was worth . .	£8	10	carats was worth . .	£300
2	" . .	16	20	" . .	3,200
3	" . .	72	30	" . .	7,200
4	" . .	128	50	" . .	20,000
8	" . .	200	100	" . .	80,000

From this it would be seen that, according to the weight, the value of the diamonds was enhanced most materially, so that, as they became heavier, they received a considerable increase, and apparently most disproportionate ratio of value. The largest diamonds are of such an enormous value that they rarely become the property of private individuals, being generally crown property. The finest private collection of diamonds he believed to be in the Bank of England, the property of the late Mr. Philip Henry Hope; there had been several lawsuits with regard to the heirship of these jewels, and the suit was yet pending in the courts. To those interested in gems and precious stones, he would recommend a visit to the Tower, to see the crown jewels deposited there; and fine specimens might daily be seen in the jewellers' shop windows in London. It might be said that it was extremely difficult to detect the diamond in its true face; but Nature had ordained that, in all inorganic substances, there should be some distinguishing mark, such as crystalline form, specific gravity, hardness, fracture. Mawe, in his account of the Brazils, says, when they were first discovered, so little was their value known, that the people used them as counters. Quartz, which is a very hard substance, crystallizes in the form of six-sided prisms, and is called in this country locally by the name of the Isle of Wight, Tunbridge Wells, and Bristol diamonds, differs from true diamond, inasmuch as it always breaks with a curved fracture, generally termed by mineralogists conchoidal, or like a shell. The topaz is usually found in the form of a rhombic prism when perfect; if the edges are destroyed by the friction of a long transport from the mountains where they are discovered, or any other cause, it breaks with a smooth fracture at right angles with the axis of the prism: it is a hard stone, and the fracture is smooth and brilliant, as if polished by a lapidary. On the contrary, the diamond breaks in four directions, which will yield an octahedron. The usual crystalline forms of the diamonds are cubes, octahedrons, and dodecahedrons, occasionally with spheroidical faces. Diamonds are never found in the form of a rhombic or six-sided prism; this is a sure guide to detect them from the others when found crystallized. In the collection he had purchased from the Duke of Buckingham, his friend Mr. Hertz had inspected a peeble with a diamond on it; he (Mr. H.) imagined that the diamond had been fastened on there by gum, or some other resinous matter; on applying boiling water, it was not found to loosen, but, by washing the soil away, it was found to be much larger than was previously imagined; in addition to this, two others were discovered, besides a large quantity of gold. This fact has induced him to bring the subject forward on the present occasion.

But, returning to the gold, he would tell them a few simple tests to detect an adulteration of the precious metal. They had heard brass filings had been exported there to mix with the gold dust; this was much lighter than gold, and readily dissolved in nitric acid. The specific gravity of gold had been tried by four different tests. The following had been the result:—15·, $15\frac{7}{10}$·, $16\frac{1}{2}$·, 17·; so that, as a mean, the specific gravity of gold was 16 times greater than water; while that of copper pyrites was 4·5, iron pyrites, 4·3, mica, 3·. The blowpipe was likewise a most useful and simple instrument; this can be used with a penny candle and a halfpenny worth of charcoal, so that, for 8d. or 10d., a primitive furnace to commence operations with can be purchased.

Gold may be cut with a knife like lead, and bent and beat out in thin leaves. Iron pyrites cannot be cut, or even scratched, with a knife. Copper pyrites can, and both are brittle. Mica, foliated and elastic. The blowpipe applied to gold, it retains its colour; while copper and iron pyrites lose theirs, and the latter becomes magnetic. Gold is also not acted upon by nitric, muriatic, or sulphuric acid singly; brass filings will be readily acted upon by nitric acid; when the two former are combined, it is only then soluble. If any of the other three minerals were reduced to powder, either of these acids will readily act on them. These were simple tests, which any one, without the slightest knowledge of mineralogy, could avail himself of. He had seen a recent work on minerals, which he wished to allude to, on account of the erroneous statement contained in it with regard to diamonds. He should not have adverted to this, but such errors in general, when they appear in print, if not corrected, go down to posterity. He says the following are tests which may be applied: "Draw a fine file over the stone, and if it be in the least scratched or abraded, it is not a diamond; if unaffected, it is a true diamond." This was not the fact; a fine file drawn over it might cause serious injury to the stone, by detaching some of the facets in the direction of the cleavage planes. He then states, if the specimen is very minute, place it between two half-crowns, and press it between the finger and the thumb—if a diamond, it will be uninjured, if not, it will break and fall to powder; this is perfectly useless, because many stones, such as rock crystal, topaz, sapphire, &c., will not be broken, or yield to the file. Another author said that a good diamond, placed on an anvil, will remain perfectly whole when struck, but an indentation will be seen in both the hammer and anvil. For his own part, he should not like to have any diamond of his subjected to such a test. The diamond is very brittle, and a valuable diamond could be broken more easily than quartz.

Dr. Mantell requested that Mr. Tennant would give some further explanation of the formation of gold and of the diamond.

Mr. Tennant said that gold was found in quartzose veins. The rock was argillaceous schist, which readily decomposes. That no doubt electricity had been at work. It was impossible to say how Nature was working in her large laboratory. The lighter particles were washed out, and the great body of the gold remained behind. So much had already been written in the newspapers about the formation of gold, that he considered it unnecessary for him to further allude to it. With regard to the diamond, a distinguished chemist had devoted several months to its study, and was about to publish a work on its properties, which, coming from so eminent man, he had no doubt would throw a great light on the subject—the gentleman he alluded to was Mr. Faraday.

Dr. Mantell observed that, according to Sir Roderick Murchison's work, gold had been discovered in diluvial deposits in Siberia; and these were generally the richest. His opinion was, that the Ural Mountains had risen in that convulsion; and he believed large deposits of gold existed in the rocks, and had been there for ages, at the same period when those large animals, now extinct, and which they knew had existed there from their carcases having been found embedded in ice. If he went to California he should seek the place where the largest pieces were to be found, and, by tracing that, endeavour to come to the fountain-head. The diamond had been considered to be a crystallised gum, or resin, from a plant. It was known to be pure carbon; and when consumed, the residue was like charcoal from a piece of wood. Sir Isaac Newton was of the same opinion of the gem—the refraction of the light being the same as on copal and amber, which were both substances of a vegetable nature.

After a few observations from Mr. Percival Johnson, who stated, that as they got deeper in the mines the gold diminished, Baron Goldsmid apologised for addressing the Society, and stated that his only motive for doing so was, to caution those young people who might not only be risking their fortunes, but their lives, by going to California. When the gold mines were first started, a company with which he was connected had raised £1,000,000 to trace the gold veins. The shares were issued at £10; and so great was the mania, that before a week was over they were worth £80; and this before a single grain of gold had been acquired. The produce of the different companies he had obtained. The Imperial Brazilian, in twenty-five years, had produced £1,513,305; Morro Velho, in ten years, £416,412; and the Cata Branca, in the same period, £240,000. That at this time, after twenty-five years' work, they had obtained their money back, with five per cent. for the last ten or twelve years; and the mines were now exhausted. The only benefit it had been to science was the discovery of palladium, which had been applied to telescopes for astronomical purposes.

Several diagrams of the different crystals of diamonds, topaz, and quartz, as well as others, giving their component parts, were exhibited.

A paper by Mr. J. Bailey Denton, A. Inst. C.E., on Model Mapping, was then read. The author, after making some valuable remarks on draining, irrigation, and the application of water as a source of power for mills, for flushing sewers, and sanatory purposes generally, proceeded to show how much more readily the capabilities of any surface can be presented to the eye by means of a model than by any delineation of it on paper. He then described his method of producing a model map. On a bed of slate (a material chosen in preference to wood or metal, as less affected by moisture, dryness, or change of temperature,) a transfer of the ground plan is made, and at the same time the levels, or contour lines, are traced on it. To erect the altitudes a simple and mechanical process is adopted; slips, or ribbons of thin copperplate, cut with accurately parallel edges of different breadths, according to scale, are prepared. These slips of copper are fitted or shaped into their appropriate contour lines perpendicularly to the slate by means of a very simple tool, described by the author, and are fixed in their places by small brads let into holes previously drilled in the slate by the Archimedian screw-drill. Each contour line has thus its appropriate ribbon. This skeleton of the model is then filled with plaster of Paris. Between the higher contours, if necessary, cork, or other suitable material, may be introduced to lighten the model. When the plaster is dry, the whole is scraped down carefully till the bright edge of each copper contour peeps to the surface. Having thus obtained an accurate and smooth face, it is only further necessary to retransfer the ground-plans to it, and, by correct delineation in appropriate oil colours, give it all the finish and characteristics of a paper plan. The geological strata can be shown by plugs inserted in the model, coloured in accordance with borings taken at corresponding spots.

The bed of slate, by screws, can easily be brought to a level, and by means of a horizontal beam, divided into feet and chains on the same scale as the model, with a spirit-level inserted in its upper surface, supported by a fixed leg at one end, with another sliding along the beam, having a vertical movement, and divided according to the vertical scale of the model, the difference of level between any points can be accurately taken.

The cost of such a model is stated by the author to be one shilling per acre, in addition to that of making the survey and taking the levels.

The author considers that no model should be made on a scale of less than four chains to the inch, and recommends three to the inch for parochial surveys, and two to an inch when the estate is small. For towns, a scale of one hundred feet, or sixty-six feet to the inch, is proposed.

Mr. F. A. Carrington also read a paper on Surface Delineation and Plan Modelling. The paper was illustrated with models and drawings.

It is a most gratifying task to remark upon the renewed prosperity of this Society, which is every year adding to the benefits it has conferred upon Art and Manufactures. The following "Address of the Council," read on the opening of the Third Annual Exhibition of British Manufactures, on the 7th of March last, so completely evidences the progress of the Society's pursuits, that we shall reprint it at length.

FIRST PROMENADE EVENING EXHIBITION.

Sir J. P. Boileau, Bart., Vice-President, in the Chair.

The Council have the great satisfaction of congratulating the Society on the opening of this the Third Annual Exhibition of British Manufactures, which they may justly characterise, not only as by far the best which has been made under the Society's auspices, but as one which, for some classes of fabrics, has never been equalled in this country; and in respect of works in the precious metals, has perhaps never been equalled in any country where similar exhibitions have been adopted as national institutions.

A success like that which now surrounds us could only have been attained by the zealous co-operation of all classes, including even royalty itself. The Council feel that this exhibition is a triumphant proof how general and hearty is the sympathy with the objects of the Society, and how earnest is the good-will to promote them.

The address of the Council on a similar occasion last year pointed out how such exhibitions were calculated to stimulate the progress of design and inventive skill, and each year to produce new achievements in art and manufactures; how that the very imperfections manifested by such exhibitions were eminently useful, as indicating the direction in which improvement should be sought; how the artist, the practical chemist, and the ingenious mechanist were thus brought into nearer relations with the manufacturer, and the latter with the public; and lastly, how the public is thus educated in the most practical way to appreciate excellence, and, by a judicious patronage, to reward all parties who have contributed to produce it.

It will not surprise members to learn that the recent exhibitions of the Society have exercised a material influence on its progress; and, unquestionably, to the deserved popularity of these exhibitions a large share of its present prosperity is due. Since the first exhibition was projected, the number of contributing members has increased from 311 to 569; and the annual income from £853 to £1430.

But it will, perhaps, cause some astonishment to those members who were rather doubtful of the policy of such exhibitions, to be told that, in fact, they are no novelty in the proceedings of the Society. Upon consulting our records, it appears that, as early as the year 1755, the Society offered prizes for the best designs for woven fabrics, carpets, tapestries, printed calicos, and paper-hangings.

So far, indeed, from these proceedings being innovations, it appears they are then, in fact, but a return to that policy with which the Society started, and which contributed to make it pre-eminent among metropolitan institutions.

CHARACTER OF THE EXHIBITION.

Members will remark that this year, for the first time, the model-room has been made available for the purposes of the exhibition; but even with this great increase of space, the Council perceived very early that it would be expedient to confine attention more particularly to the collection of only a few classes of manufactures. The Council, therefore, resolved to direct their efforts to producing a successful display of manufactures in metals, especially the more precious, in paper-hangings, and in wood-carving; at the same time not in anywise excluding specimens of other manufactures which might be offered. The Council may congratulate the Society on having made, on this occasion, the finest exhibition in these three departments that has ever been formed. Such a collection of modern gold and silver plate has never been made before for public exhibition. The contributors to this noble show of British works have been—

HER MOST GRACIOUS MAJESTY,

THE DUKE OF RICHMOND,
THE DUKE OF BEDFORD,
THE MARQUIS OF EXETER,
THE EARL OF CHESTERFIELD,
THE EARL OF ALBEMARLE,
COUNT BATHYANY,
SIR MOSES MONTEFIORE,
MR. BOUVERIE,
MR. R. COBDEN, M.P.
MR. GREVILLE, and
MR. H. T. HOPE, M.P.

The last, upon being requested to exhibit one of his specimens made by one manufacturer, generously stipulated that he would give permission on condition that the work of another firm was likewise shown, thus marking his sense of the value of such an exhibition to the best interest of the manufacturer.

Many of these beautiful specimens have been executed as prizes for racing-plate; and the Society hope that these exhibitions, which afford the means of enabling the public to share in the gratification afforded by such works of art, may help to check a growing tendency on the part of owners of winning horses to elect to receive coin in preference to plate.

The exhibition of British paper-hangings is as complete a representative of the present state of that manufacture as that of the precious metals is in its way; and it encourages the hope that, when our schools of design are made as efficient as they are capable of being made, the English paper-stainer, instead of generally borrowing his patterns from the French, will be able rather to furnish his rivals, as he was accustomed to do half a century ago. Indeed there are some specimens in the present collection which will be found to have a national originality and excellence of their own. The Society are indebted for this display to the assistance of Mr. W. B. Simpson, who has induced some of the most eminent manufacturers to co-operate with him on this occasion.

It was the suggestion of his Highness the President that prizes should be offered for wood-carving executed by artisans who were not professional wood-carvers, with a view of encouraging a home occupation, such as prevails in Switzerland and Germany, secondary to other pursuits. The result has been most satisfactory as a beginning; and the Council feel assured that the Society will applaud the wood-carving executed by the son of the gatekeeper at Hyde Park Corner, to whom the first prize has been awarded.

The Council congratulate the several manufacturers in glass on having this year made considerable advances, and they regret that some specimens were received too late for reward; they acknowledge the continued and successful efforts of Messrs. Minton in pottery; and the Council have had the satisfaction of electing Herbert Minton, Esq., an honorary life member, in testimony of his constant and praiseworthy efforts to promote the advance of British manufactures, and the welfare of the Society.

For the first time in the career of the exhibitions, silks, carpets, lace, and shawls have been shown; and the specimens, though not numerous, are of first-rate quality. The Council propose next year to bestow special attention on woven fabrics generally; and they feel satisfied that our weavers and decorative printers of woven fabrics will duly follow the gracious example of the Queen, and promote the success of these exhibitions by their contribution of specimens. The Council would just add one sentence here, which is, that it is an object of these exhibitions to show the best fabrics *actually manufactured for sale*, rather than patterns which are manufactured as exceptional examples for exhibition only.

As remarked last year, the sincere hope of the founders of these exhibitions was, that the exhibition of each year might become the parent of a higher state of art and manufactures, and of a succeeding exhibition much more perfect; and this hope is fully realised in the present year. The Council may apply what they said of the exhibition of 1848, to the exhibition of 1849 with increased emphasis. The subjects this year, as compared with the last, are more numerous, more important, of improved design as works of art, and of improved quality as articles of manufacture.

STUDENTS' AND ARTISANS' PRIZES.

Referring to the rewards and encouragement held out to *students* by the Society, the Council have great satisfaction in observing that the modified views of the last two or three years, in respect to the list of *subjects* for premiums, and the class of artists invited to compete, are beginning to be responded to. This exhibition convincingly proves that the alteration was made in perfect accordance with the changed wants of the age, and the new class of students rapidly forming in all parts of the kingdom in the lately established schools of design; students, it should be remembered, belonging mostly to a rank of society which renders peculiarly necessary the stimulus of such rewards. Art, as applied to manufactures, has made steady progress since the change; and several works which have this year been rewarded with premiums show a diligent study of nature, and, at least, an ambition in applying such study to ornamental decoration. A new class has at the same time been added; and the Society has endeavoured (with some success) to stimulate the art-workman, whose excellence in his craft, in many branches, lies between and unites the designer's skill with the manufacturer's capital, and whose merits and excellence has for too long a time been neglected.

COMPETITION.

The Society will have observed that, for three years past, a prize of twenty guineas has been offered for the best design for a silver cup, of which the design should be emblematical of justice. The Council felt that, in having to present a cup according to the will of the late Dr. Swiney, it was peculiarly within the province of the Society to provide that it should be an appropriate and fine work of art.

The Council find that an open competition has not produced a work worthy to be executed. Many designs have been submitted, but none such as would be deserving of the object, or the Society's sanction. At the outset, the Council feared that the best artists, whose abilities already command full occupation, would not be induced to enter into competition; but they thought it right to submit the prize to all who might be disposed to compete for it. Not having succeeded, the Council have called in the advice of a distinguished artist, one preeminently calculated to assist the Society in the production of a suitable goblet. Mr. D. Maclise, R.A., has agreed to afford his aid; and the Council trust that, when the distribution of the prizes takes place, they will have to exhibit to the members a goblet well worthy of the Society's sanction as a work of art.

NATIONAL EXHIBITION.

The Society is aware that these exhibitions, necessarily limited each year to certain classes of manufactures, are only part of a series of exhibitions which it is proposed shall culminate every fifth year in a large national exhibition, embracing ALL manufactures. The revolution of the first fifth year will arrive in 1851; and the Council feel that it will be necessary forthwith to mature those arrangements for giving due effect to this event, which have already been successfully instituted and carried to a certain point with the President of the Board of Trade, and the Chief Commissioner of Woods and Forests. The Board of Trade has already promised co-operation; and the Chief Commissioner of Woods a suitable site for the building in which the exhibition may be made. It only remains for the Government to take the risk of providing a temporary building of dimensions sufficiently ample for the purpose. The Society of Arts having practically demonstrated the means of establishing such exhibitions, and educated most successfully a numerous public of all classes of society to appreciate them and crowd to see them,—having induced the noble designers, the most eminent manufacturers, ingenious mechanics, skilled workmen, and the men of science, all to assist in these exhibitions,—having been aided by the active co-operation and good-will of the most distinguished among the nobles and the commons of our country in lending specimens for exhibition,—enjoying the benefit of the personal interest and advice of his Royal Highness Prince Albert, as the head of the Society,—and having been honoured with the direct and practical assistance even of our most gracious Sovereign, in promoting the success of these exhibitions, the Council feel that they shall be warranted in preferring a request to her Majesty's Government to do its part in this great object, and to provide once in every fifth year a suitable building in which a national exhibition, duly representing the best productions in all branches of British manufactures, may be formed. The Society's First Annual Exhibition was visited by about 20,000 persons, the second attracted a concourse of more than 70,000 persons, and should the popularity of the present more interesting exhibition than any preceding increase in a proportionate ratio, the Council will be prepared on behalf of the Society to present a petition to the House of Commons, and to wait on the Prime Minister, requesting that arrangements may be made to provide a proper building for the Great National Exhibition in 1851.

MONTHLY NOTES.

MR. HARDING'S DRAWING LESSON DESK.—Messrs. Winsor and Newton of Rathbone Place, London, have favoured us with a sketch and description of a useful "lesson desk," lately invented by Mr. J. D. Harding, the artist. The object of the new desk is, a convenient means of bringing together, and displaying the original in the same machine with the drawing-book or paper to receive the copy. When closed it has the appearance of, and occupies no more room than, a portfolio. It consists of two framed pieces, one of which, when open for use, is nearly vertical, and carries the original drawing; the other is hinged to it at a short distance from its edge, and lays down in a sloping position to support the paper for the copy. A rack attached to the bottom of the upright frame projects beneath the one on which the copy is to be made, and sets it to the angle required. In addition to its uses as an ordinary desk, it will be found useful for copying music, and for other purposes, where a convenient holder of the original is an advantage.

NON-CORROSIVE INK FOR STEEL-PENS.—Every one feels the inconveniences arising from the corrosion of metallic pens by the action of the ink; and in spite of all the numerous inventions of "galvanic pens," and new chemically compounded inks, no adequate remedy has yet appeared. A correspondent informs us, that having observed that iron, when immersed in a solution of soda, would not rust, he tried its effect in common ink, and finds that its presence effectually prevents corrosion upon the pen. He states that a very small amount only is necessary.

IMPROVED NIGHT LIGHTS.—We were lately shown, by Messrs. M'Culloch of Argyle Street, a series of novel arrangements for Night Lights, which present many advantages over the old rush-light, and its successor the floating oil-light. The burning material is a composition, moulded into short thick candles, and weighted at the bottom. These are set in small glass stands, and, upon igniting the wick, the heat melts down the candle, which fills the stand, whilst the wick is kept upright in the middle of it by its weight. When placed in opal glasses, the lights have a very fine appearance, and when fitted with stand or circular wall reflectors, a remarkably good clear light is produced. The light is also modified for ship's use, or for conveying from place to place, so as to avoid spilling the liquid, by fitting up the stands in a universal-jointed ring. One of the moulds, to burn five hours, costs a halfpenny.

NEUBER'S PLACARD-HOLDER.—The clumsiness of the present system of locomotive placards has induced Mr. Neuber, of Long Acre, to devise a more manageable and convenient affair. A light frame, supported on four standards, carries the bill or placard. These standards are set two and two, and each pair has a shoulder-strap to go upon the shoulders of the carriers, whilst, at their lower ends, is a leather strap to pass round the body, and retain the whole frame steady. In this way the men's hands are left at liberty, and they at the same time possess a far better command over their burden than if they merely carried it in their hands.

Baskcomb's Triune Sporting Cart.—This vehicle, designed by G. H. Baskcomb, Esq. of Manor House, Chiselhurst, Kent, is so contrived as to be capable of conversion into three different kinds—a "dog-cart," with dog-basket, a game "trap," with wire and network game-holders, and a trotting "trap" alone. When in its simplest state, for mere travelling alone, its appearance is somewhat like the ordinary conveyance of the same name, but lighter, the seat being entirely supported by four stays from the shafts. The dash-iron, in place of being made of the whole width of the vehicle, is curved inwards to a narrow top, thus giving it a much handsomer appearance, and facilitating the getting in and out. The draught is from the axle, by attaching chains to it where the springs are placed; these chains are passed through eye-pieces carried by the cross-bar of the shafts, and having spring-hooks by which they are attached to the traces. For carrying dogs, the open space enclosed by the four standards of the seat is filled in with a basket, attached by thumb-screws, and opening from behind. Four small hooks are attached beneath the seat for the purpose of supporting a game-net when the dog-basket is removed. In each combination, considerable ingenuity has been manifested in contriving elegancies of shape, in which Mr. Baskcomb has been most successful. The design is an example no less of his taste than of his ardour in mechanical pursuits, as the conveyance, of which we have a drawing before us, was executed by himself.

Sargison's Straw-Shaking Machine.—A good contrivance for separating grain from straw has long been much needed by farmers, who lose a good deal of their produce for want of an efficient shaker. Mr. Sargison of Wisbeach has turned his attention to the point, and has successfully introduced a shaker of a simple and most effective kind. The shaking sieves are long and narrow, being thin metal plates each screwed down upon the edges of two narrow wooden bars as supports. They are three in number, and are placed parallel to each other, the two outer ones being worked in concert by two horizontal crank shafts set in the framing beneath them, whilst the centre one is in like manner worked by another pair of cranks. The sieves are perforated with holes varying according to the kind of grain, from $\frac{1}{4}$ inch to $1\frac{1}{2}$ inch in diameter. The crank shafts of the sieves move in opposite directions, and communicate a most effectual shaking movement to the straw, a row of spikes being set on the edges of the sieves to assist in carrying the straw from the feeding to the discharging end of the machine. The power required to drive it is not more than that of a common dressing-machine; and from the peculiar and effective shaking motion which it gives, it is evident that scarcely a grain can be lost by it, from cole-seed down to a large Windsor bean.

Mr. Walker's New System of Sketching.—Mr. Rawson Walker of Coburg Place, Bayswater, London, has introduced a novel style of sketching, whereby natural objects can be delineated with great rapidity and ease. The effect of these drawings resembles that of mezzotinto engravings, with a greater amount of sharpness than even these engravings possess. By the ordinary method of drawing, the lights are produced by the tedious and difficult process of surrounding them with a dark colour, and, for this reason, crayon drawings are generally confined to the representation of dark objects upon a light ground. In Mr. Walker's method, lights may be put in with a facility quite equal to oil-painting, and any texture may be faithfully given with an ease unknown in the ordinary routine of drawing.

Improved Metallic Pen.—An ingenious addition to the common metallic pen has been made by Mr. Jackson of George Street, Birmingham, whereby the common inconvenience resulting from the crossing of the points is avoided. In place of cutting out a complete hole at the top of the slit, Mr. Jackson leaves the cut portion fast to the body of the pen, and bends over the piece so as to press slightly against the lower portion of the slit, in the inside. This tongue-piece not only performs this valuable office, but assists materially in retaining the ink in the pen, without risk of blotting. A far greater quantity of ink may be taken up by it than with the common pen, as the bent tongue acts as one side of a receiver for containing the fluid.

Marshall's Ink-Stand and Clip-File.—The thickening of writing-ink, by evaporation and the deposition of dust, is a continued source of discomfort to writers. To obviate this great inconvenience, Mr. Marshall of Cheltenham has introduced a self-acting door, which opens only for the admission of the pen to the ink, and immediately closes when it is withdrawn; so that the entrance of dust is completely prevented. The inkstand on the table before us is of glass, with a flat bronzed top, having a species of pyramidal chamber formed upon its upper surface. One of the sloping sides of this chamber acts as the entrance for the pen, which is closed by a slip of metal bent over the top of the chamber, to form a back equipoising piece, whose weight always retains the door up against the opening, except when the pen presses against it to reach the ink. Being nicely balanced, the slightest pressure of the point of the pen opens the door, without harming the pen's point in the least.—The clip-file, invented by the same gentleman, is simply a slip of mahogany, having an angular edge-piece, against which a strip of brass is attached to eyes by a piece of vulcanized india-rubber at each end. Through the centre of the brass strip, a stout metal pin projects from the angular edge of the mahogany holder; and upon this pin, the letters, pamphlets, or loose papers are passed, the partially flexible binding strip of brass being withdrawn to allow of the papers being put on, and again hooked upon an eye, when fixed. We have a clip by us, the size of the *Practical Mechanic's Journal*, which answers exceedingly well for holding such periodicals. The elastic connections of the binding strip allow of any moderate number of parts being put on the file, short pins being carried by the inner side of the strip, for securing the parts quite parallel.

ENGLISH PATENTS.

Sealed from 14*th March*, 1849, *to* 19*th April*, 1849.

Alfred Vincent Newton, Chancery-lane, mechanical draughtsman,—"Improvements in the manufacture of piled fabrics."—(Communication.)—March 19th.

Joseph Beranger, of the firm of Beranger & Co., of Lyons, France, civil engineer,—"Improvements in weighing machines."—19th.

Thomas Henry Russell, of Wednesbury, patent tube manufacturer, and John Stephen Woolrich, of Birmingham, chemist,—"Improvements in coating iron and certain other metals and alloys of metal."—19th.

Samuel Hall, of King's Arms Yard, Coleman-street, London, civil engineer,—"Improvements in apparatus for effecting the combustion of fuel and consuming smoke, and for preventing explosions of steam-boilers and other accidents to which they are liable."—19th.

George Knox, of Moorgate-street, London, Secretary to the Shrewsbury and Birmingham Railway Company,—"Improvements in railway carriages."—19th.

Alexander M'Dougall, of Longsight, Lancashire, chemist,—"Improvements in recovering useful products from the water used in washing and in treating wool, woollen, and cotton fabrics, and other fabrics."—20th.

William Harrison Pickering, Liverpool, merchant,—"Improvements in evaporating brine and certain other fluids."—(Communication.)—20th.

Charles William Siemans, Birmingham, engineer,—"Improvements in engines to be worked by steam and other fluids, and in evaporating liquids."—20th.

William Parkinson, Cottage-lane, City-road, Middlesex, gas-meter manufacturer, successor to the late Samuel Crosley,—"Improvements in gas and water meters, and in instruments for regulating the flow of fluids."—20th.

John Macintosh, Bedford-square,—"Improvements in furnaces and machinery for obtaining power, and in regulating, measuring, and registering the flow of fluids and liquids."—24th.

Alexander Parkes, Harborne, Stafford, chemist,—"Improvements in the deposition and manufacture of certain metals and alloys of metals, and improved mode of heating and working certain metals and alloy of metals, and in the application of the same to various useful purposes.—26th.

John Mason, Rochdale, Lancashire, machine-maker, and George Collier, Barnsby, Yorkshire, manager,—"Improvements in machinery or apparatus for preparing and spinning cotton and other fibrous materials, and also improvements in the preparation of yarns or threads, and in the machinery or apparatus for weaving the same."—26th.

Stephen White, Victoria-place, Bury New-road, Manchester, gas engineer,—"Improvements in the manufacture of gases, and in the application thereof to the purposes of heating and consuming smoke; also improvements in furnaces for economizing heat, and in apparatus for the consumption of gases."—26th.

David Henderson, London Works, Renfrew, Scotland, engineer,—"Improvements in the manufacture of metal castings."—26th.

George Thomson, Camden-road, cabinet-maker, and James Elms, of the New-road, gentleman,—"Improvements in machinery for cutting and tying up firewood."—28th.

William Buckwell, of the Artificial Granite Works, Battersea, Surrey, civil engineer,—"Improvements in compressing or solidifying fuel and other materials."—28th.

Richard Satchell, Rockingham, Northampton,—"Improvements in machinery for depositing seeds, and hoeing and working land."—28th.

Pierre Rene Guerin, Havre,—"Improvements in steering ships and other vessels."—28th.

Charles Green, Birmingham, patent brass tube manufacturer, and James Newman, Birmingham, manufacturer,—"Improvements in manufacture of railway wheels."—28th.

James Thomson Wilson, of Glasgow,—"Improvements in the manufacture of sulphuric acid and alum."—28th.

George Henry Manton, Dover-street, Piccadilly, gun-maker, and Josiah Harrington, Regent-circus,—"Improvements in priming, and in apparatus for discharging fire-arms." 28th.

William Norton, Lascelles Hall, Lepton, Yorkshire, fancy cloth manufacturer,—"Certain improvements in the production of figured fabrics."—28th.

François Vanillon, Princes-street, Hanover-square, manufacturer,—"Improvements in making hats, caps, and bonnets."—28th.

William Hartley, Bury, Lancashire, engineer,—"Certain improvements in steam-engines."—28th.

John Britten, Birmingham, manufacturer,—"Certain improvements in the means, apparatus, and appliances for cooking, preserving, preparing, and storing drinks and articles of food, and in preparing materials for constructing the same; also in constructing vertical roasting jacks and chains for the same, applicable to other chains, parts of which improvements are applicable to other similar purposes."—28th.

James Lawrence, the Elder, Colnbrook, Middlesex, brewer,—"Improvement or improvements in brewing worts for ale, porter, and other liquors, and in storing ale, porter, and other liquors."—28th.

William Beckett, Northwich, Cheshire, draper, and Samuel Powell, Witton, in the same county, foreman,—"Certain improvements in the manufacture, making, or construction of certain articles of wearing apparel."—28th.

James Fletcher, Salford, Lancashire, manager, and Thomas Fuller, Salford, aforesaid, machinist and tool-maker,—"Certain improvements in machinery, tools, or apparatus for turning, boring, planing, and cutting metal, and other materials."—28th.

Osborne Reynolds, Dedham, Essex, clerk,—"Certain improvements in railways."—28th.

Thomas Harrison, Liverpool, merchant,—"Certain improvements in the construction of baking ovens, and also certain machinery for working or using the same."—28th.

Henry Howard, Railway-place, Fenchurch-street, London,—"Certain improvements in the manufacture of glass; also in the construction of furnaces for melting and fining the same."—28th.

A grant of an extension of a patent for the term of four years, from the 4th instant, of an invention for a certain improvement or certain improvements in the making and manufacturing of axletrees for carriages, and other cylindrical and conical shafts, to Charles Geach and Thomas Walker, the assignees of James Hardy, the original inventor.—April 2d.

William M'Bride, jun., Sligo, Ireland, but now of Havre, France, merchant,—"Improvements in the apparatus and process for converting salt water into fresh water, and in oxygenating water."—2d.

Alfred Vincent Newton, Chancery-lane,—"Improvements in separating and assorting solid materials or substances of different specific gravities."—2d.

Samuel Alfred Carpenter, Birmingham, Warwickshire, manufacturer—"Certain improvement in or substitute for buckles."—3d.

Alfred Woollett, Liverpool, artist,—"Improvements in gun carriages."—3d.

Wiiliam Parry, Plymouth, Esq.,—"Certain improvements in shoeing horses and in horse shoes."—3d.

Henry Dunington, Nottingham, manufacturer,—"Improvements in the manufacture of looped fabrics, and in the making of gloves and hatbands."—3d.

James Godfrey Wilson, engineer, Chelsea, and William Pidding, Elizabeth-street, Pimlico,—"Improvements in obtaining perfect combustion, and in apparatus relating thereto, the same being applicable to every description of furnace and fireplace, as also to other purposes where inflammable matter or material is made use of."—3d.

Gaspard Brandt, Little Gray's-Inn-lane, Middlesex, machinist,—"Improvements in the construction of the bearings of railway engines, and railway and other carriages now in use."—13th.

James Childs, Earl's-court Road, Old Brompton, Middlesex, wax bleacher,—"Improvements in the manufacture of candles, night lights, and candle lamps."—16th.

Thomas Cocksey, Little Bolton, Lancaster, millwright, and James Nightingale, Brightines, of the said county, bleacher,—"Certain machinery to facilitate the washing and cleansing of cotton and other fabrics, which machinery is applicable to certain operations in bleaching, dyeing, printing, and sizing warps and piece goods."—16th.

Louis Prosper Nicolas Duval Piron, engineer, Paris,—"Certain improvements in tubes, pipes, flags, kerbs for pavement and tram roads."—16th.

Charles Shepherd, Leadenhall-street, London, chronometer maker,—"Certain improvements in working clocks and other time-keepers, telegraphs, and machinery by electricity."—16th.

Robert Clegg, Joseph Henderson, and James Calvert, Blackburn, Lancaster, manufacturers,—" Certain improvements in looms for weaving."—16th.

John Ruthven, engineer, Edinburgh,—" Improvements in preserving lives and property from water and fire, and in producing pressure for various useful purposes."—16th.

William Henry Phillips, York-terrace, Camberwell New Road, Surrey, engineer,—" Improvements in extinguishing fire, in the preparation of materials to be used for that purpose, and improvements to assist in saving life and property."—16th.

William Little, Strand,—" Improvements in the manufacture of materials for lubricating machinery."—16th.

William Edward Newton, Chancery-lane, civil engineer,—" Improvements in machinery for the manufacture of net lace or other similar fabrics."—16th.

William Hyde Knapp, Long-lane, Borough, Southwark, chemist,—" Improvements in preparing wood for the purposes of matches and firewood."—17th.

Thomas Nicholas Greening, of the firm of Messrs. Burdekins and Greening, Sheffield, cutlery manufacturers,—" Improvements in knives and forks."—17th.

Alexander Alliott, Lenton Works, Nottingham, bleacher,—" Improvements in apparatus for ascertaining and for marking or registering the force or pressure of wind, of water, and of steam; the weight of goods or substances, and the velocity of carriages; also an apparatus for ascertaining, under certain circumstances, the length of time elapsed after carriages have passed any given place, and for enabling the place or direction of floating bodies to be ascertained."—17th.

George Remington, Warkworth, Northumberland, civil engineer,—" Certain improvements in locomotive, marine, and stationary steam-engines, and in hydraulic and pneumatic engines."—17th.

William Edward Newton, Chancery-lane, civil engineer,—" Improvements in boilers or steam generators."—(Being a communication.)—17th.

Henry Bessemer, Baxter-house, Middlesex,—" Improvements in the methods of extracting saccharine juices from the sugar cane, and in the manufacture of sugar, as also in the machinery or apparatus employed therein."—17th.

Robert Gordon, Heaton Norris, Lancaster, engineer,—" Certain improvements in the ventilation of mines."—19th.

N.B. This patent was not sealed till the 19th, but bears date the 4th of April, instant, per order of the Lord Chancellor, being opposed at the Great Seal.

John Ormerod, Holt Holme Mill, near Newchurch, Lancaster, spinner,—" Improvements in carding cotton and other fibrous substances."—19th.

IRISH PATENTS.

Sealed from 20th March 1849, to 20th April, 1849.

John Haris, 4, Richard's-terrace, Albion-street, Rotherhithe, Surrey, engineer,—" A mode or modes of founding type, and of casting in metal, plaster, and certain other materials."—24th March.

Walter Richards, Edinburgh, type-founder,—" Improvements in casting printing-types, and other similar raised surfaces, and also in casting quadrats and spaces."—3d April.

James Henry Staple Wildsmith, City-road, experimental chemist,—" Improvements in the purification of naphtha (likewise called wood-spirit, and hydrated oxide of methyle), pyroligneous acid, and cupion, and certain other products of the destructive distillation of wood, peat, and certain other vegetable matters; and of acetate of lime and shale; and in the purification of coal, tar, and mineral naphtha; likewise spirit, being the product of fermentation."—3d.

Stephen White, Victoria-place, Bury, New Road, Manchester, Lancashire, gas engineer,—" Improvements in the manufacture of gases, and in the application thereof to the purposes of heating and consuming smoke, also improvements in furnaces for economising heat, and in apparatus for the consumption of gases."—19th.

SCOTCH PATENTS.

Sealed from 22d March, 1849, to 21st April, 1849.

Charles Henri Paris, in the Republic of France, manufacturer,—" Improvements in preventing the oxidation of iron."—March 26th.

William Edward Newton, Office for Patents, 66 Chancery-lane, Middlesex, civil engineer,—" Improvements in machinery for hulling and polishing rice and other grain seeds."—26th.

James Fletcher, Salford, Lancashire, manager at the works of Messrs. William Collier and Company, Salford, aforesaid, machinists and tool makers, and Thomas Fuller, Salford, aforesaid, machinist and tool maker, a partner in the said firm,—" Certain improvements in machinery, tools, or apparatus for turning, boxing, planing, and cutting metal and other materials."—26th.

Walter Neilson, Hyde Park-street, Glasgow, engineer,—" A certain improvement, or certain improvements in locomotive engines."—27th.

Jean Adolphe Carteron, Paris, Republic of France, now of the Haymarket, Middlesex, chemist,—" Certain improvements in dyeing."—27th.

David Henderson, London Works, Renfrewshire, engineer,—" Improvements in the manufacture of metal castings."—29th.

William Longmaid, Beaumont-square, Middlesex, gentleman,—" Improvements in treating the oxides of iron, and in obtaining various products therefrom."—April 4th.

Francis Hay Thomson, Hope-street, Glasgow, M.D.,—An improvement or improvements in smelting copper or other ores."—11th

Clemence Augustus Kurtz, Wandsworth, Surrey, gentleman,—" Certain improvements in looms for weaving."—(Communication.)—11th.

Barthelemy Thimounier Ainé of Amplepius, Department de Rhone, Republic of France, engineer,—" Improvements in machinery for sewing, embroidering, and for making cords or plats."—11th.

Alfred Vincent Newton, Office for Patents, 66 Chancery-lane, Middlesex, mechanical draughtsman,—" Improvements in the manufacture of piled fabrics."—(Communication.)—13th.

Arthur Dunn, Dalston, chemist,—" Improvements in ascertaining and indicating the temperature and pressure of fluids."—13th.

Jeremiah Brown, Kingswinford, Staffordshire, roll turner,—" Certain improvements in rolls, and machinery used in the manufacture of iron, also in rolls and machinery for shaping or fashioning iron for various purposes."—13th.

William M'Bride, jun., Sligo, Ireland, but now of Havre, Republic of France, merchant, —" Improvements in the apparatus and process for converting salt water into fresh water, and in oxygenating water."—(Communication.)—16th.

John Ruthven, engineer, Edinburgh,—" Improvements in preserving lives and property from water and fire, and in producing pressure for various useful purposes."—17th.

William Henry Balmain, and Edward Andrew Parnell, St. Helens, Lancashire, manufacturing chemists,—" Improvements in the manufacture of glass, and in the preparation of certain materials to be used therein, parts of which improvements are also applicable to the manufacture of alkalies."—17th.

Stephen White, Victoria-place, Bury New Road, Manchester, Lancashire, gas engineer, —" Improvements in the manufacture of gases, and in the application thereof to the purposes of heating and consuming smoke, also improvements in furnaces for economising heat, and in apparatus for the consumption of gases."—19th.

Charles Alexandre Broquette, Rue Neuve St. Nicholas, St. Martin, Republic of France, chemist,—" Improvements in printing and dyeing fibrous and other materials."—20th.

Soren Hjorth, Jewry-street, Aldgate, London,—" Certain improvements in the use of electro-magnetism, and its application as a motive power, and also other improvements in its application generally by engines, ships, and railways."—20th.

James Hart, Bermondsey-square, engineer,—" Improvements in machinery for manufacturing bricks and tiles, parts of which machinery are applicable to moulding other substances."—20th.

DESIGNS FOR ARTICLES OF UTILITY.

Registered from 17th March, 1849, to 12th April, 1849.

March 17th, No.	1815.	Thomas Eldrid, Fore Street, Crippelgate,—" Sandwich-case."
—	1816.	John Fernihough & Sons, Duckinfield,—" Steam-boiler."
—	1817.	W. & A. Munro, Edinburgh,—" Locking wheel."
—	1818.	Henry Smith and Thomas Willey, Liverpool,—" Switches for tram railroads."
20th,	1819.	John Young, Wolverhampton,—" Lock sash-fastener."
21st,	1820.	Joseph Sayce, Cornhill,—" The piuma coat."
23d,	1821.	John White Little, Bath,—" Passengers' luggage label."
24th,	1822.	William Burgess, Blackfriars Road,—" Gutta Percha ferrule."
26th,	1823.	John Fuller & Co., Long Lane, Southwark,—" The bona fide ventilating hat."
—	1824.	Peter Rothwell Jackson, Salford Rolling Mills,—" Improved railway waggon for minerals."
27th,	1825.	John Skillicorn and W. H. Ogden, Liverpool,—" Improved multiplex water-closet."
28th	1826.	J. J. Welch and J. S. Margetson, Cheapside,—" University jacket."
—	1827.	George Osborne, Gondhurst,—" Portable commode."
—	1828.	Brown, Marshall, & Co., Birmingham,—Railway waggon."
29th,	1829.	Henry and John Foster, Liverpool,—" Telegraphic ship signal-lantern."
30th,	1830.	William Bennett, Percival Street, Goswell Road,—" Shaving-brush.
31st,	1831.	Richard Jones, Carr Street, Ipswich,—" Improved fire-escape."
—	1832.	John Whitehead, Preston,—" Reciprocating spiral motor."
April 3d,	1833.	Benjamin Nicoll, Regent's Circus, and Lombard Street,—" Jackets for rowing, cricketing, &c."
—	1834.	Francis B. Oerton, Walsall,—" Bit for horses."
—	1835.	Richard Garrett, King Street, Whitehall,—" Double piston cornopean.
4th,	1836.	George Carrington, Birmingham,—" Wedding-ring strainer."
5th,	1837.	John Howard & Son, Bedford,—Horse drag-rake."
7th,	1838.	Stephen Hartley, Chelsea,—" Artificial bird-shooting machine."
10th,	1839.	Michael James Brown, Oundle,—" Tile and pipe machine."
—	1840.	Bryan Donkin & Co., Bermondsey,—" Cock for water, steam, gas, &c.
11th,	1841.	George White, Jersey,—" Chimney-pot or ventilator."
12th,	1842.	Thomas Walker, Birmingham,—" Rotating heel for boots and shoes."
13th,	1843.	William Cook, Regent Street,—" Transverse or cross connectors to inverted double C springs and others."
14th,	1844.	Alexander Speirs, Vauxhall Foundry, Liverpool,—" Hydrant or water valve."
—	1845.	Alexander Robertson, Dublin,—" Gum elastic breast reliever."
—	1846.	Henry Thompson, Long Acre,—" Jaw for metallic joints."
16th,	1847.	J. J. Welch and J. S. Margetson, Cheapside,—" Elastic aerial stock or tie."
—	1848.	W. Arkell and W. Jackson, Cheltenham,—" Fore carriage framing."
—	1849.	William Gent, Bennett's Hill, Birmingham,—" The Gemini coat."
17th,	1850.	Joseph Wilson and C. P. Woodfin, Hull,—" Double stench trap."
18th,	1851.	Henry Alexander Bodien, Pentonville,—" False bottom and tube for flower-pots."
—	1852.	George Forrester & Co., Liverpool, parts of a hydrant."

TO READERS AND CORRESPONDENTS.

Wanted.—A rule by which to find the H. P. necessary to work a malleable iron making establishment; also the H. P. required for blowing two Blast Furnaces, the area of twyere holes for each furnace, being 40 square inches—" Charlie."

R. S.—We have now addressed him twice, as requested. It is a very unsatisfactory mode of correspondence; to ensure certainty, he ought to entrust his name and address to our keeping.

A Beginner, Manchester.—Unless we wrote a treatise expressly dedicated to his tuition in steam engineering, we do not think we could give him further information. In calculating in the way he mentions, he must deduct 2 lbs. per square inch of the piston, as an average of the loss by friction. For an example, see page 27, of our first volume.

J. Newton, Stavely.—He may harden the parts in heated oil, or in an animal charcoal chamber.—See Holtzapffel's "Turning and Mechanical Manipulation." There are a great many grease compositions. Palm oil is ordinarily used for carriage-axles. Buchanan on " Mill-work," or Holtzapffel, will afford him an answer to his third question.

Errata in April Number.—Page 2, 2d column, 1st line of table "Old System," for 6s. 6d., read £6 6s. *per ton;* in 2d line, for 4s. 10d., read £4 10s. *per ton;* 4th line, for 5s. 6d., read 5s. 6d. *each;* page 3, 1st column, 3d line of table, for, at £10 6s., read £6 6s. *per ton.*

G. Shardlow, London.—Can he forward us a few general particulars of the action of his instrument, which is very imperfectly set forth in the note received?

W. R. K., London.—The attachment of a signal line to the lever of the locomotive whistle, as pointed out in our pages by two correspondents, is certainly far better than the plan of placing a bell upon the tender, actuated in a similar manner. If he can point out any objections to a whistle signal of this kind, which do not obtain in his arrangement, we shall be glad to reconsider the subject.

Electrical Improvements.—In the letter of " R. E. R.," at page 18 of our last number, some unaccountable and annoying errors have occurred. The third sentence of the third paragraph ought to read—" This is accomplished by the cohesive affinity existing between mercury and hydrogen, so that the latter element adheres to the former, *and effectually prevents local currents.*" The portion in italics having crept into the conclusion of the ninth sentence of the same paragraph. The remainder of the paragraph immediately following the part just quoted, ought to follow the third sentence of the third paragraph. As the letter now reads, it presents some absurdities, which, uncorrected, may go far to nullify the valuable remarks of our correspondent. We can only account for the derangement of the matter, by stating that the MS. was somewhat incoherently drawn up.

Mr. Garret.—His drawing has been received, and will meet with attention in due course.

The several communications on the subject of the " Question in Frame-work," will be attended to next month.

RAILWAY FERRY.

BROUGHTY HARBOUR.

Fig. 1.

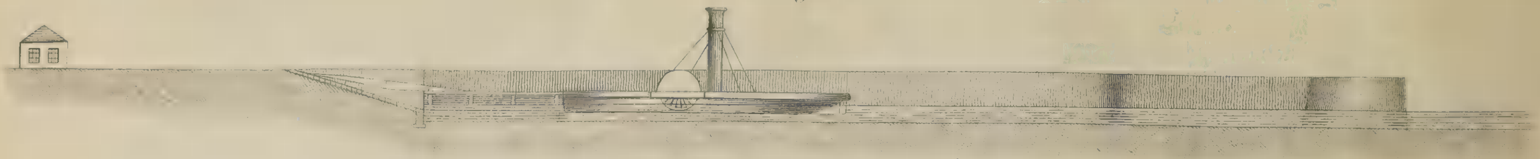


Fig. 2.

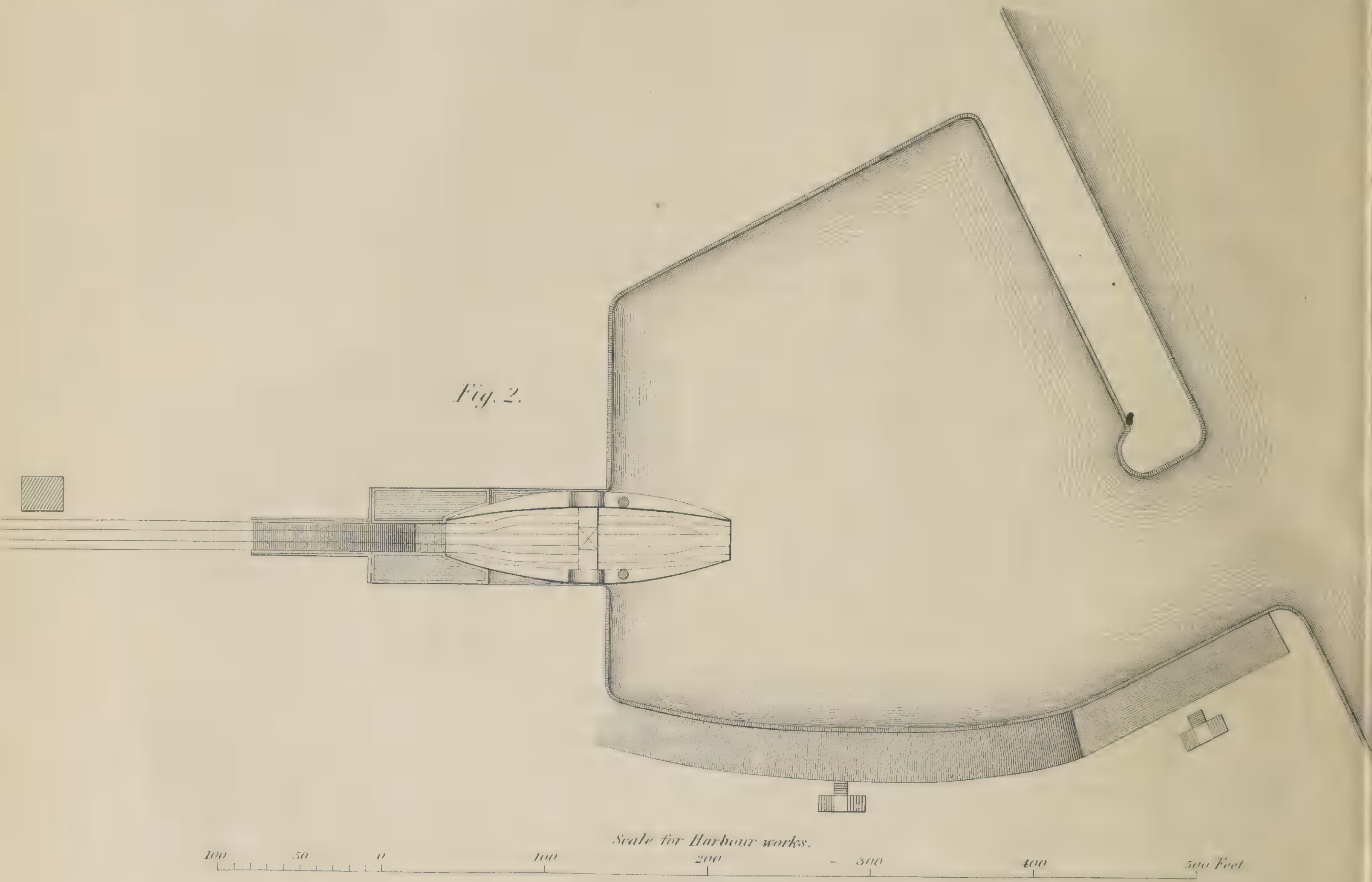


Fig. 3

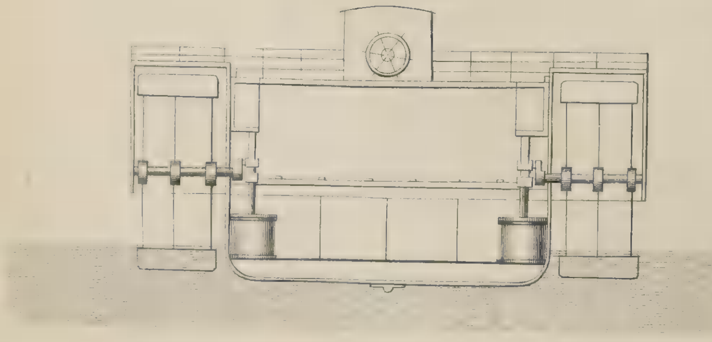
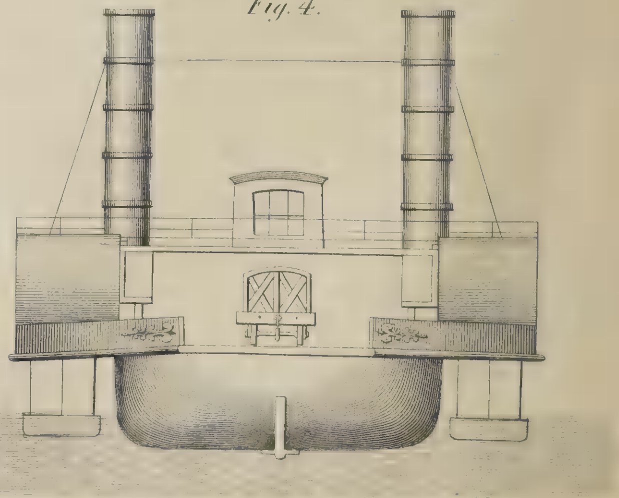


Fig. 4.



W. Johnson.
Patent Office, Glasgow.

Printed by Maclure & Macdonald, Lithographers, Glasgow, Liverpool & London

Geo. Aikman Edin^r

FLOATING RAILWAY ACROSS THE TAY, ON THE LINE OF THE EDINBURGH AND NORTHERN RAILWAY.

(*Illustrated by Plate* 30.)

We have all heard of, and wondered at, the "hanging gardens" of Babylon, little thinking that the craft of the engineer of the 19th century would produce a parallel wonder—at least in name. So it is, that the matter-of-fact results of the application of modern mechanism, present, in their analyses, curiosities and marvels, rivalling those of the "Thousand and One Nights." We need not go far for instances of practical curiosities, for every manufactory affords some of them; but there are, perhaps, none more interesting than what is popularly known as the "floating railway."

The Edinburgh and Northern Railway, where this scheme is shortly to be put in operation, is one of the most important of the Scottish lines, stretching, as it does, from Edinburgh to Perth and Dundee, and forming the highway of communication between the metropolis and the important towns of Montrose, Aberdeen, and other places on the north-east coast. In the forty-seven miles intervening between Edinburgh and Dundee, there are two great breaks affecting the continuity of the traffic—the Granton and Burntisland ferry on the Forth, at the southern end; and the Broughty and Ferry-Port-on-Craig on the Tay, at the northern extremity.

The first of these is five miles in length, and here the efficient ferry steamers of the ordinary class are employed to keep up the connection; but in the latter case, where the width of water to be crossed is no more than about 7-8ths of a mile, the novel plan we are about to describe has been arranged to save the trouble and delay of unloading and reloading goods. The old system of unloading waggons into vessels and reloading at the other side, would act most injuriously upon a heavy traffic; and when the line was proposed to terminate at Ferry-Port-on-Craig, this objection at once presented itself. As a remedy in some degree, it was proposed to place the goods in carts, and ship the whole right across; and on a small scale, this answers tolerably well, but will not answer where the line, as in this instance, runs in connection with others, although it is the expedient at present to a certain extent, and was adopted by the Messrs. Cameron when they were carriers on the line. Mr. Grainger, the engineer of the company, then proposed to the directors, the plan of carrying the loaded waggons directly across the ferry on board a steamer expressly built for the purpose, and thus it is proposed virtually to extend the railway across the river, by turning the deck of a steamer into a moveable length of rail. The possible success of the scheme has been proved on the Burntisland ferry, where upwards of 600 unloaded carriages, waggons and trucks, as supplied to the company by various contractors, have been carried across on the decks of the ordinary ferry steamers. Each steamer took a dozen trucks—each weighing 3 tons 8 cwt., or altogether 40 tons 16 cwt., safely across in pretty rough weather.

After determining upon Mr. Grainger's proposal, various plans were proposed for expediting the shipment and disembarkation of the carriages; and ultimately, a floating railway stage, extending from the termination of the fixed rails, to the deck of the steamer, was adopted—a small stationary engine being employed to draw up and let down the carriages along the inclined rails.

To contain the floating stage, recesses are being formed at the upper ends of the two harbours at Broughty and Ferry-Port-on-Craig, the positions being chosen with a view to screening the stage and vessel as much as possible from the action of the sea, as any sidelong movement would act injuriously upon the connections, and interfere with the operations of embarking. As illustrations of the general features of the works, Mr. Grainger has obligingly furnished us, through Mr. Forsyth, who has been practically engaged in working out the details of the scheme, with drawings, from which we have produced the three plates to accompany our description.

Plate 30 shows the general arrangements at the Broughty harbour, on the Dundee side of the river. Fig. 1 is a longitudinal section through the harbour, representing the steamer or "floating railway," in connection with the caisson and stage, and the house containing the small stationary engine employed in raising and lowering the carriages to and from the steamer's deck. Fig. 2 is a complete plan of the harbour corresponding with the float, stage, and steamer, the high and low water landings, and the quays for the ordinary traffic accommodation. Fig. 3 is a transverse section of the steamer through the engine-room; and fig. 4 is an end elevation of the same, showing a goods van on the central line of deck rails, with the bridge and wheel-house for the steersman above, and the positions of the engines.

The recess in which the steamer is received, is made sufficiently long to take in about two-thirds of its length, and is a few inches more in width, to admit of freedom of action, as the tide rises and falls, and to prevent a sideway yawing. The float or caisson, as marked upon the sheet, is of wrought-iron, the lower end of the inclined portion of the railway stage being jointed to its surface and carried upon it, so as to maintain a landing always level with the steamer's deck at any state of the tide. The upper end of the stage is similarly jointed, by strong hinges, to the inner or landward end of the chamber. It is of wrought-iron, trussed, and covered with timber, on which two lines of rails are laid, the central space being guaged so as to serve as a main centre line, thus giving three lines of way in the breadth of two, and superseding the employment of switches or shifting points. Its length is 100 feet, by 22 feet in breadth. To the lower end of the stage, a short gangway, continuing the rails outwards, is attached by means of hinges at one end, the contrary end being hinged to the vessel, thus allowing for any slight variation of level between the vessel and the float.

At high water, the float, stage, and vessel are level with the quay, and with the rails upon it; and the loaded waggons and carriages are then easily run in and out of the vessel by hand or otherwise. At low water, with a fall of 16 feet, the stage has an inclination of 1 in 6.25, and the carriages are then shifted by the stationary engine, set a little back from the stage, and working three endless chains, one for each line of rails. These chains pass round drums at the top of the incline, and are carried on sheaves down the stage, and turned on pulleys at the float, passing up on sheaves beneath the stage to the drums at the top. Whilst the vessel is loading or discharging, the waggons are attached to the chains by means of a tail-rope, friction couplings being employed as a ready and safe means of coupling the engine with its work.

The steamer, which is now approaching completion at Mr. Robert Napier's Lancefield Dock, in the Clyde, is 170 feet in length, 55 feet over the wheels, and 10 feet in depth, having two disconnected steeple engines of 100 horse power each. The engines are placed, one on each side of the vessel, close up to the paddle-boxes, each engine working its own paddle—the intermediate shaft being left out to afford a clear space on deck for the trains of carriages. At first sight it would appear that the adoption of detached engines would involve a considerable irregularity of propulsion, but it is found from practice, that by a little attention on the part of the enginemen, one of whom will be placed at each engine, no disadvantage will be felt from this cause. A late trip which the vessel took down the Clyde in some degree proved this, as, with the exception of an occasional perplexity of the captain in giving his orders for the working of two separate engines instead of one, the vessel made steady way. If the disconnected system answers in other respects, it will be found valuable in getting the vessel in and out of harbour when full of shipping; and this idea has had its weight in the decision of the engineer in not fitting up a connecting shaft, which, however, may be easily done at any future time, should it be found necessary.

Each engine has a steam-cylinder of 56 inches in diameter, and 3 feet

6 inches stroke, with gun-metal air-pumps, barrels and buckets, and rods of Muntz metal. The paddle-wheels are 22 feet in diameter and 10 feet broad. The framework conveying the motion from the piston to the crank-shaft, consists of a polished metal cross-head, curved upwards, and forming the base of a triangle, the two sides of which are composed of flat parallel bars, connected by stud-bolts, and attached to each end of the cross-head. The upper ends of these bars are brought together to form the apex of the triangular frame, and, from this point, the connecting-rod descends to the crank. The steam is supplied from two boilers, at a pressure of 10 lbs. per square inch. These boilers have flues carried to the outer sides of the vessel for the take-up of the funnels, which are placed one on each side, leaving a clear space on deck of 27 feet in breadth, from stem to stern, for the standage of the waggons.

To render the vessel complete as a ferry-boat, both her ends are built alike, each having a rudder, so as to save turning. The steering-wheels are placed on the bridge between the paddle-wheels; they work the rudders by means of chains passing beneath the deck to each end.

On her trial trip in the river, the vessel attained a speed of eight miles an hour; when fully loaded, it is supposed she will cross the ferry in ten minutes. The amount of delay in the traffic of the line at each side of the river, caused by loading or unloading, will probably be 30 or 45 minutes, so that the river will not offer even so great an obstruction as the break of guage on a railway of similar importance.

The following additional views of the ferry-works are engraved for issue in the July number:—A plan and section of Ferry-Port-on-Craig Harbour, with steamer, stage, and float, corresponding to the drawings in plate 30; and a second plan and section of the Harbour and Works, with the stationary engine and gearing for the inclined stage on a larger scale. With these plates will also be given a specification and details of the steamer.

SCHIELE'S ANTI-FRICTION CURVE.

The great practical defect in revolving valves of all classes, is the gradual deterioration and looseness arising from their working action, and to this may be added, the overpowering friction produced by forcible tightening up. In this objectionable feature is to be found one of the fundamental causes of the failures of so many rotatory engines, in which the irregular end-wear of the pistons has, until lately, been deemed to be beyond remedy.

The conical plugged stop-cock affords one of the best known examples of the injurious effects of irregular friction. The amount of wear at the larger end differs from that at the smaller one, because every point in the former has a longer frictional traverse than any point in the latter. To lessen the evil, it is necessary to make the plug nearly cylindrical; and the consequences of this modification are—first, that a comparatively trifling pressure causes the plug to stick in its socket like a wedge; secondly, the bore, instead of being cylindrical, as it ought to be to give the fluid a free passage through it, must be made flat; and thirdly, very little wear causes the plug to sink considerably in its socket, from which results the necessity of making the shells and plugs long and heavy.

The friction between a plug and its socket divides itself so, that the product of the pressure, multiplied by the length of way, is the same for any point in the rubbing surfaces. The length of way being different in different parts, the pressure must differ also: it is greatest at the smallest end. Now, as the larger end must be tight, as well as any other part, the abrasion or destructive wear of the smaller parts is obvious.

Mr. Schiele, of Corporation Street, Manchester, had his attention drawn to the matter some time ago, and for the improvements he introduced he obtained a patent in 1848. Considering the truncated cone of the stop-cock plug to be divided into a series of infinitely short lengths, he proposed to take a more obtuse cone for each larger portion, and in such progression that it would require equal pressure for every portion of the surface to cause a uniform sinking of the plug in the course of wear. The contour thus obtained is of a peculiar curve, as shown in fig. 1. The main feature of the generating curve for such a surface, is the equality of all tangents drawn from the curve surface to the axis; hence the use of the simple instrument illustrated by fig. 2. This contrivance consists merely of a straight brass wire, A, jointed at one end by a pin to the upper surface of a small wooden slider, B, which is hollowed in the centre to receive the tip of the finger in drawing a curve. A small drawing-pen, C, ingeniously formed out of a slip of steel bent over the wire, A, and screwed to a brass bush, so as to form two broad nibs, is arranged to slide from end to end of the wire, being adjustable at any point by stiff friction, caused by a spring, which, fitting a groove in the wire, retains the vertical position of the pen. In drawing a curve, the rod or wire carrying the pen is set at right angles with the slider, B, which is drawn in a right line along the edge of a ruler, whilst the wire carrying the pen is left to find its way from its initial angular position, to that of a line in the same plane as the slider; and, in doing this, the pen describes the curve we have represented.

Fig. 1.

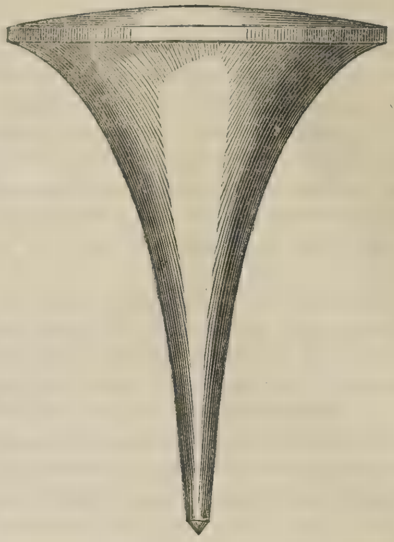
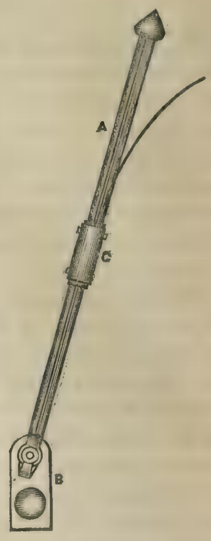


Fig. 2.



1-2 size.

Fig. 3.

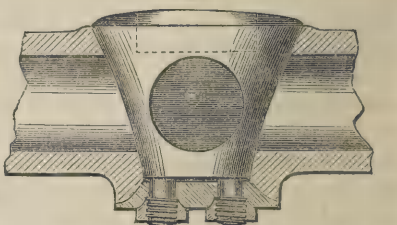


Fig. 3 represents a vertical section of the shell of a stop-cock, the plug of which is formed upon the principle of the new curve. From the peculiarity of its shape, it may be called the bell-cock. Quite free from the imperfections of the ordinary cock, this possesses the natural tendency of insuring tightness by wear.

Figs. 4 and 5 represent an elevation and vertical section of a locomotive engine regulator, constructed on the same principle; here the amount of friction varies with the pressure of steam which acts against the journal.

Fig. 4.

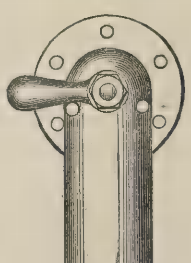
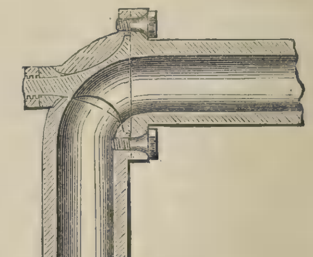
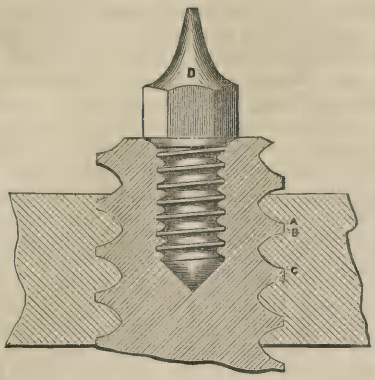


Fig. 5.



In fig. 6, the curve is applied to the threads of a square-threaded screw. The proportions preferred by the patentee, are, — A B, one-fourth of A C, and A C, one-fourth, one-eighth, or one-twelfth of the diameter. The plan is of course applicable to all kinds of revolving valves for steam-engines, which, when constructed on the true curve principle, may in many cases be substituted for slide-valves. Revolving joints in pipes; the different centres, journals, and spindles of lathes, as at D, fig. 6; centres for railway turntables; footsteps for upright shafts; shaft couplings; screw collars, as in the holding screws in fig. 5; glass stoppers, and innumerable arrangements which these examples will point out, may be greatly improved by the adoption of Mr. Schiele's plan.

Fig. 6.



The friction is a minimum, and equal to $\frac{8\ G.\ L.\ N.\ P.}{C.\ (D^2 - d^2)}$ where

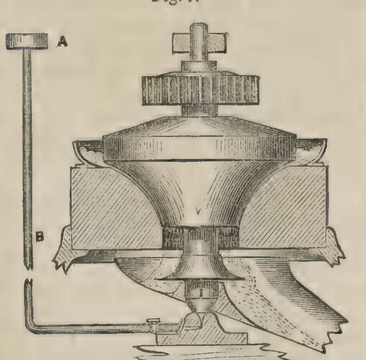
$P =$ the whole pressure which the rubbing surfaces have to bear in the direction of their axis;
$D =$ the diameter of the larger part;
$d =$ the diameter of the smaller part;
$L =$ the length of the generating curve;
$G =$ the distance of the centre of gravity of the curve from the axis;
$C =$ co-efficient of friction; and
$N =$ number of revolutions.

The curve is one of great beauty, and is most accurately drawn by the simple instrument we have described, one of which we have now by us. Various applications of it have received an ample practical test; and in this, Mr. Fairbairn of Manchester has afforded the inventor some important assistance, by permitting trials to be made upon his locomotive engines. Mr. Schiele is, we believe, the maker of most of the articles and movements to which the new curve is applicable, as well as of the drawing apparatus, which involves some niceties in its construction.

For the heavy footsteps of shafting, we should suppose the new form to be peculiarly valuable; for, as they at present exist, with curves of all shapes, no set rule is followed, and inordinate friction and wear is unavoidable.

Apparently, one of the most valuable of the applications of the curve is to the grinding surfaces of mill-stones, as in the vertical section, fig. 7, where the gradual variation of the curvature, in relation to the increasing distance of the parts from the centre of motion, equalizes the rubbing pressure in the most perfect manner. The same sketch also shows the adaptation of the principle to footsteps, together with a new system of lubrication of these surfaces so liable to extreme abrasion. The oil supply is kept in an elevated vessel, A, whence a pipe, B, proceeds downwards to the footsteps, upon which a pressure is thus constantly kept by the oil column, a stop-cock being introduced to regulate the supply.

Fig. 7.



The lift-valves of pumps may be judiciously constructed with the curved seat, as also the axle-trees of carriages. The result of certain experiments lately made by the patentee, are such as to show, most completely, that all the working surfaces in machinery, which bear a pressure in the direction of their axes of revolution, have a greater amount of frictional wear than such as are curved in the manner Mr. Schiele has proposed. In a future page we shall be able further to illustrate the results obtained, and to exhibit the extensive applications to all classes of machinery of which the new principle is capable.

CARBONIC ACID GAS ENGINES.

In the attempts at the employment of the highly elastic gases as a motive power, the great impediment to success has been their expense as compared with the cheapness of steam. The least costly of the liquefiable gases is carbonic acid. It is given off in great abundance in lime-burning, and other manufacturing processes. But cheap as this gas is, it was found by Mr. Cheverton to involve by far too much expense, if allowed to escape after being used.

Liquid carbonic acid, if placed in a vessel exposing a moderate surface to the action of the atmosphere, might be made to work an engine with a pressure of 24 atmospheres with very little trouble—the only question being that of expense. The evaporation of the liquid would speedily reduce its temperature, possibly from 45° to 5°, at which it might be retained by the heat communicated from the atmosphere. It would, at this temperature, possess an elastic force equal to 310 lbs. on the square inch.

To generate the gas, chalk and dilute sulphuric acid might be used to obtain a first supply, leaving a residuum of sulphate of lime. The gas, after passing through the engine, might exhaust upon quicklime, by which it would be absorbed, and the carbonate of lime formed, could be used with acid as the generating substance; so that sulphate of lime, for which there exists a sufficient market, would be the resulting substance.

The question then is—Will the plan be as cheap as steam? I will state a few facts that I have ascertained, and any interested reader may judge for himself. 18 lbs. of coal are required to convert a cubic foot of water into steam, at a pressure of 50 lbs. to the square inch. To obtain a cubic foot of liquid carbonic acid, 1000 lbs. of the carbonate of lime and 400 lbs. of sulphuric acid are necessary. I ascertain this from the facts, that 100 grains of carbonate of lime and 40 grains of sulphuric acid produce 100 cubic inches of carbonic acid. 450 inches of gas, when condensed, form 1 inch of liquid, which, being multiplied by 1728, (the number of inches in a cubic foot,) gives the weight of the lime in grains, $\frac{4}{10}$ of the quotient showing the weight of acid. Quicklime, when exposed to the action of carbonic acid, gains nearly half its weight, or 44 per cent.

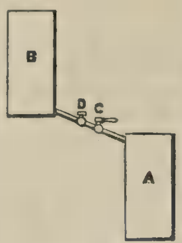
We have then the cost of 560 lbs. of quicklime; add 400 lbs. of sulphuric acid, less the value of 1000 lbs. of sulphate of lime, compared with the cost of 18 lbs. of coal. Take also into account the vast labour that is required to form the carbonic acid.

The difference of pressure does not interfere with the calculations, because we have no sure evidence against the assumed law, that a given volume of any liquid developes the same amount of elasticity in a gaseous state.

There is, however, another way by which this acid may be adapted as a motive power. It is to use it so that the acid is not exhausted into the atmosphere and lost, but condensed and re-used. Messrs. Cheverton and Brunel adopted plans in conformity with this principle. Mr. Cheverton says, it is a "*sine qua non*" that the acid should not have a chance to escape through any joint; therefore he conceived his cumbrous and expensive, yet ingenious plan. I have confidence that the progress of mechanical skill justifies the use of this gas in an ordinary engine. I will describe a plan I had arranged, before I knew that any machine had been planned, with the view of employing this agent as its prime mover. The generating and condensing vessels only need be described. The former ought to be placed in a large vessel filled with water, and formed of the most imperfect conducting substance compatible with the circumstances.

For any given amount of pressure, all gaseous bodies contain an equal quantity of heat, at whatever temperature they may be used. Therefore, a considerable fire would be required to sustain the temperature of the liquid acid during its evaporation. For this purpose let the generating vessel have as many copper tubes passing longitudinally as can possibly be placed in it, without injuring its strength, so that the heat of the surrounding medium may be quickly imparted to the cooling acid. Heat the water to 100°, and the elasticity of the acid will be equal to 1200 lbs. on the square inch, at which temperature it should be kept. Now, after allowing the gas to pass through the engine, it may be forced into the condensing vessel, and formed into liquid by a pressure of 900 lbs. on the square inch, provided the temperature of the vessel be retained at 66°, which might easily be done. We have, by this means, an effective power of 300 lbs. on the inch.

The liquid must be transferred from the condensing to the generating vessel, and for this purpose let the bottom of the former vessel be higher than the top of the latter, as in the annexed figure, so that any fluid unopposed may flow freely down a pipe that connects the bottom of B to the top of A. In the pipe are two stop-cocks, C and D. Suppose C open and D closed, while each cylinder is half full of liquid carbonic acid, A exerting a pressure of 1200 lbs., and B of 900 lbs., their working condition. The pipe is filled with gas from A to D, and in the liquid from



B to D. Let C be closed and D opened, and the liquid by its specific gravity will descend to C, while the gas occupying the space between C and D will rise into B. Now let D be closed and C opened, and the liquid will, from the same cause, readily flow into A. The engine might easily be made to work the stop-cocks with perfect accuracy, and the capacity of the tube between the stop-cocks could be arranged to suit the consumption of acid.

The cost of working an engine with this agent would differ from that of steam in the much less radiation from the boiler and fire of the former, consequent upon their much lower temperature. I cannot say to what amount the saving of fuel would extend; it must, I fancy, be very considerable, at least ¼.

If adopted as an auxiliary to the steam-engine, I believe it would be of great value, especially in steam-ships, where cold water is cheap, and the reduction of the amount of fuel required is of great importance. The exhaust steam from an engine would fully suffice to raise the temperature, so as to gain nearly double the power without any expense. The saving would be in this instance 100 per cent., less the radiation from the generating vessel, and the cooling of the gas in passing through the cylinder, say 10 per cent. Thus an engine equal to 50 horse power would, by the addition of the carbonic acid engine, be equal to 95 horse-power.

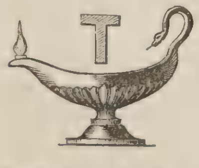
A great desideratum would be obtained in locomotives, namely, the same power with half the weight of boiler, half the consumption of coke, and half the weight or required bulk of water. To keep the condensing vessel cool in this case, it might be much exposed to the action of the atmosphere, or surrounded by another tight vessel, to the top of which the suction-pipe of the force-pump might be attached, the bottom having communication with the water in the tender, so that a constant supply of cold water would act upon the condensing vessel.

To assist me in arriving at a satisfactory conclusion upon the supposed existence of any flaws in my theory, I have consulted the new volume of the Cavendish Society, "Gmelin's Hand-Book of Chemistry," and have had my convictions and results greatly strengthened by the investigation. After a lengthened and minute examination of a number of authorities, he gives, as the law of the specific heat of gases, that, on the cooling of a given volume of any gas, an equal quantity of heat is given off from each, and that the pressure is in all cases equal to its density, so that all gases exerting a pressure of equal force upon a given area, lose the same quantity of heat in escaping. It is this law that has always stood in the way of the use of the highly volatile liquids, as ether, for the production of a motive power.

The principle may be stated thus:—If a steam-boiler requires 200 lbs. of coal to enable it to supply an engine of given power with steam at 400°, a carbonic acid boiler would require 200 lbs. of coal to supply the given engine with gas at 60°, less the inferior radiation of the latter, which, on my former supposition, would reduce the weight of coals required to 150 lbs. But when the waste heat of exhaust steam can be employed, the equation is something like the following:—Power of steam used, minus radiation of exhaust pipe and carbonic acid boiler, equal the power of auxiliary engine, or 100 horse engine — 10 horse-power lost by radiation by the steam exhaust pipe and carbonic acid generating vessel = the power of carbonic acid engine. To obtain the effective power of which, we must deduct the radiation from its cylinder. This would be the case, provided the condensing vessel can always be surrounded by water at its ordinary temperature, or by some means kept at the ordinary temperature of the atmosphere. This, I believe, to be a correct statement of the principle.

Perhaps the most effectual manner of applying the waste steam would be to surround the carbonic acid boiler with water, into which the steam cylinder may exhaust, and this water would again be used to supply the boiler; this plan might be arranged to act as a condenser to the steam-engine, rather than to prevent the free egress of the steam.—R. E. R.

ARTIFICIAL LIGHT—OIL LAMPS.



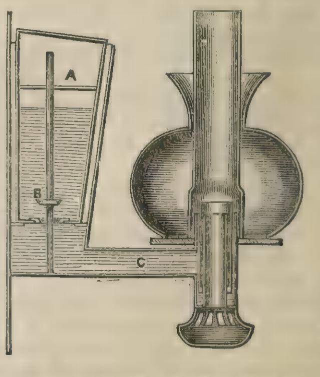
TO prolong the natural duration of day has evidently formed a subject for the exercise of the inventive faculties of the earliest races of mankind. What were the primary forms of light-giving apparatus may safely be left to the determination of the poring antiquarian, without the risk of leaving a blank in the notes here thrown together on the subject. Doubtless, torches, flambeaux, or other contrivances of a similar nature, came—literally enough—to light first; after these, we have the original classes of candles, oil-lamps, gas in its thousand and one forms, the oxy-hydrogen, and, lastly, that vast nonentity the electric light. The whole of these lights are yet found available under some one or other circumstance; but, as the title of the present notice indicates, we shall refer only to the second in our enumerative list, which, in its general principles, has remained almost unchanged since a date with which we cannot charge our memory.

A simple cup of oil, with a partially immersed fibrous material, figures in the earliest known prints of lamps, and this form still exists to a great extent without modification. The initial sketch in this article exhibits the rare beauty of form to which the ancients attained in connection with a contrivance so utterly unphilosophical. The very general introduction of coal gas has, latterly, circumscribed the bounds of other lights; but there is yet a wide field where, from local or other causes, it cannot approach. Without reckoning the objections that are taken against the effects of gas, as injuring the appearance or texture of materials, many isolated cases occur where coal gas cannot be obtained, and here the oil-lamp comes prominently forward as the best-known substitute. In the combustion of oil in the earlier lamps, as before noticed, no provision was made for the due preservation of the level of the liquid at the point necessary for the regular and efficient action of the lamp. It is towards this particular that modern practice has been chiefly directed, so as to give to this light all the regularity of the best gas-flame. Notwithstanding the innumerable modifications which have been brought forward with this view, it is only recently that it can be fairly said to have been accomplished. The action of a lamp unprovided with a true compensating arrangement for the retention of the proper level of the liquid is analogous to that of an ordinary candle, where, as the tallow is consumed, the wick becomes carbonized, and must be periodically removed to prevent detriment to the light.

Amongst the first plans put in operation for this purpose, is to be reckoned the arrangement embodied in the astral lamp. In this lamp the variation of the oil level is, to a great extent, diminished by the peculiar construction and situation of the reservoir. This is of a flat annular form, surrounding the burner, and on a level with it. The oil is supplied to the burner through the tubular supports of the reservoir. In this arrangement, although the flat shape of the reservoir will admit of a considerable quantity of oil being consumed, with a proportionably small depression of its level, still the reservoir cannot be made so flat as to prevent a considerable sinking of the oil in the burner, without very much diminishing its capacity. Notwithstanding, this lamp came very generally into use, and still continues to be employed to a considerable extent; the introduction, however, some years ago, of the solar lamp, very materially lessened its popularity. In the last-named lamp, singularly enough, we find no attempt at preserving the level of the oil, its superiority arising from the application of an annular disc of metal near the base of the flame. This metallic ring is called a deflector, and has for its object the deflection of the current of air passing to the flame, in such a manner as more effectually to perform its important office in the process of combustion; by this means a greater brilliancy of flame is produced.

In adverting to the burner, it may be well to remark that the lamps just described, as also those which we purpose further to notice, are supplied with the well-known invention of Argand. This burner, which may be classed as one of the greatest improvements which has been applied to lamps, is so universally understood, that it is needless to notice it further here.

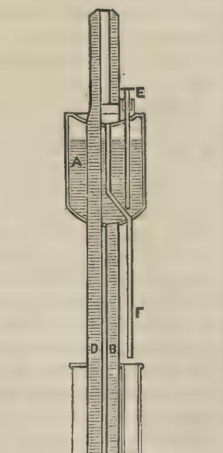
We shall only mention one other modification of lamp, where a regularity of the oil level is sought to be obtained, simply by a different arrangement of the parts, and shall then describe the best attempts which have come under our notice, to effect this by means of mechanical or other contrivances.



In the lamp now under consideration, the reservoir is placed on one side of the burner, the lower part of the former being nearly on a level with the top of the latter. The oil is supplied to the wick by a tube passing from the bottom of the reservoir, and opening into the burner. At first sight it might be imagined that an overflow would be the unavoidable result of this arrangement; but when it is considered that the top of the reservoir is air-tight, and, consequently, that the pressure of the atmospheric air on the surface of the oil is thereby removed, it will at once be understood by any one, who has observed the action of the ordinary fountain attached to bird-cages, how the oil is sustained. In the accompanying section of this lamp, A is the oil reservoir, closed at the top, and having a conical valve, B, opening upwards in its bottom. The reservoir fits into an outer case, loosely enough to admit air between the two. C, Is the tube which conducts the oil from the bottom of the reservoir to the burner. To fill the lamp with oil, the reservoir, A, is withdrawn from its case, and, being inverted, the valve falls inwards, leaving an opening for the introduction of the oil. When full, the opening is closed by pulling up the wire attached to the valve, and the reservoir is then returned to its place. When in this position, the valve is elevated by its wire resting on the bottom of the case—leaving a discharge opening for the oil which flows from the reservoir into the casing to supply the burner. When the level of the oil in the casing reaches the bottom of the reservoir, the further admission of air is thus stopped, and consequently the flow of oil ceases until the level in the casing again sinks below the opening, and allows the air to enter. Various modifications of this lamp have been introduced, with a view to render its practical application as convenient as possible, and its adoption has thereby been considerably extended. This lamp possesses an advantage over those already described, in as far as the oil does not at any period sink so low in the burner—being from time to time restored to its proper level: the effect of this is, that the flame, instead of gradually becoming less and less powerful as the oil in the reservoir diminishes, is weak and powerful by turns, and retains, to a great extent, its original average brilliancy during the entire time of combustion. The form of this lamp very much impairs its usefulness as a table-lamp—the shadow cast by the reservoir being very objectionable; its adoption is therefore limited to situations where this is of no moment.

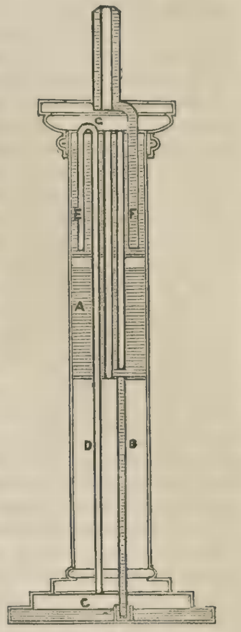
From what has been said, it may be gathered that no plan has been hit upon, whereby the objections referred to have been obviated entirely by any mere alteration in the arrangement of parts; and we question whether, in this way, that end could be attained: at all events, we may presume that it was this difficulty that first gave rise to the various attempts which have since been made to produce the desired effect by mechanical and other means. This, then, leads us to the consideration of a few of the many contrivances of this nature which have come under our notice; and in doing so, we shall confine ourselves to such as appear worthy of remark from their practical utility, or are rendered interesting by the ingenuity displayed in their contrivance.

Amongst the various means employed for preserving an efficient supply of oil to the wick, the principles of specific gravity and hydrostatics, compressed air, pumps and pistons, have been most extensively adopted, each of which we shall consider in its turn. The well-known fact, that the density or gravity of some bodies or fluids is greater than that of others, at once explains how the principle of specific gravity becomes subservient to the purpose we are now considering; and having a substance of so low a specific gravity as oil to deal with, there is no difficulty in obtaining another fluid of a specific gravity sufficiently high to answer our purpose. Mercury, from its weight, is the first that naturally attracts attention. This fluid is capable of supporting a column of oil 14 or 15 times higher than itself, and, from this circumstance, would seem to be well adapted for the end in view. From other causes, however, it is found objectionable, and chiefly from its corrosive effect upon the metals of which lamps are usually constructed: this is obviated by forming those parts of glass where the contact of the mercury might cause injury. A lamp of this kind was tried, but has not been successful.



It is to M. Thilorier that we are indebted for a lamp upon this principle, wherein, discarding the use of mercury, he employs a solution of sulphate of zinc—which being of sufficient gravity, and having no prejudicial effect upon the metal of the lamp, is found to answer in a superior manner. In this lamp there is no overflow from the burner, and during the course of an evening the oil does not sink to any material extent; the light afforded by it is brilliant, and is maintained in a very equable manner during that time. No doubt it would have been more extensively adopted but for the practical difficulties attending its management, accompanied by a tendency to become extinguished by any sudden rise of the oil column, which is very readily caused by motion in carrying, or otherwise.

The annexed engraving exhibits a vertical section of this lamp. A, Is a reservoir containing a solution of sulphate of zinc, communicating by a vertical tube, B, with the lower portion of the oil reservoir, C, at the foot of the lamp. The pressure thus given to the oil elevates column in the tube, D, ascending to the burner. To obviate the variation which would be caused by the sinking of the zinc solution, a small tube, E, is fitted into the top of the reservoir, A, its lower end reaching nearly to the bottom. As the zinc solution threatens to sink, air enters through this tube in single bubbles; then, as the effective height of the zinc solution is measured from the bottom of the air-tube, no variation can take place until it falls to that level. The tube, F, serves to conduct any oil which may overflow from the burner, into a vessel placed below for its reception.



The subjoined engraving represents a lamp by M. Girard, which, from the principle it involves, is termed the "Hydrostatic Lamp." Here the weight of a column of oil is employed to force up another column to the burner, by descending into an air-chamber, communicating, by a tube, with a second reservoir of oil placed above it. The weight of the first column causes a compression of the air in the chamber, which, escaping through its connecting tube to the second oil reservoir, presses upon the surface of the oil, thus elevating a column so as to reach the burner. This lamp is on the principle of Hero's fountain, and may be described as follows:—A, Is the reservoir for the actuating column of oil communicating by a tube, B, with the air-chamber, C, at the bottom of the lamp; the descent of the oil from A, into the air-chamber, causes a compression of the contained air, which acts through the tube, D, on the surface of the oil in the upper reservoir, E, raising a column through the tube, F, to the burner; the tube, G, which forms a communication between the external air and the bottom of the reservoir, A, answers the same purpose as the air-tube described in Thilorier's lamp. To render the actuating column still more regular, the foot of the tube, B, dips into a narrow cup at the bottom of the air-chamber. By means of this arrangement, together with that of the air-tube, no variation takes place in the length of the actuating column, until the oil sinks below the level of the air-tube, or rises in the air-chamber above the edge of the cup. To counteract the effect of the sinking of the oil in the reservoir, E, the upper end of the compressed air-tube, after rising to the top of the reservoir, is bent downwards, so as nearly to reach the bottom. In this way, the compressed air, in passing down the bent portion of the tube, has to overcome the reactive pressure of a column of oil equal to the depth of the oil contained in the reservoir; and as the latter sinks, the reactive pressure diminishing in the same ratio, offers less resistance to the passage of the air along the tube.

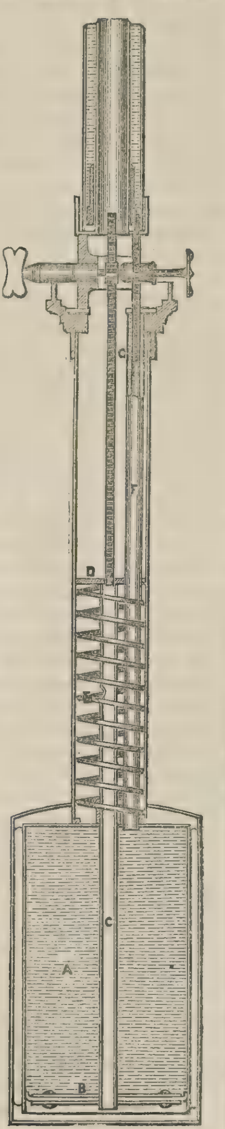
Where compressed air is employed for supporting the column of oil, the lamp is constructed with two chambers, one to serve as the reservoir for the oil, and the other for the compressed air. The air, in this instance, is supplied by means of a small hand-pump attached to the lamp. The air-chamber communicates by a tube with the oil reservoir, and the pressure thus caused upon the surface of the oil raises it to the required height. The entire elevating power, resulting from the compression of the air, is obtained by a few strokes of the pump, previous to putting the lamp into operation. The gradual diminution of the elastic pressure of the air, added to the variations caused by change of temperature, have occasioned many difficulties in the way of a due regulation of the height of the oil column, and although various contrivances have been resorted to, nothing has as yet been found to answer the purpose.

Carcel was, we believe, the first to employ what may be strictly termed a mechanical arrangement for elevating the oil. In this lamp the oil is raised to the wick by means of a series of pumps, set in motion by a train of clockwork, concealed in the base of the pedestal. In this way, an excess of oil is continually supplied to the wick, the surplus flowing back into the reservoir. This lamp has come into general use on the Continent, and it certainly produces a light of great regularity and brilliancy. Upon a close analysis of its action, however, a great defect is apparent in the continual abstraction of the heat of the flame, by the return of the excess of oil to the reservoir, and in so far the overflow is very objectionable, as cold oil is constantly presented to the flame, which, in a lamp of a uniform oil level, would become heated, and consequently more fitted for combustion. Owing to the delicacy of its mechanism, this lamp is also liable to frequent derangement, and its costliness has led to various methods of obtaining the same end by simpler and more economical means.

Of the plans that have been devised for this purpose, probably the best is that of a piston working either upwards or downwards in a cylindrical oil reservoir, and impelled by a weight or spring. The different modifications of these lamps are so numerous, that it would be quite impossible to attempt a general notice of them; but of the number which deserve remark for a certain degree of peculiarity, is one of French invention, where the piston is raised by means of a screw-spindle, the threads of which form a very acute angle with the axis. This screw works in a nut in the centre of the piston, which is prevented from revolving by means of vertical guides. The screw receives a rotatory motion from a spring coiled in a box at the base of the lamp. In this way the piston is forced upwards, raising the oil by its pressure through a tube to the burner, the supply to which is regulated by a stop-cock.

The principal objection to this lamp is, that there is no self-adjusting contrivance for regulating the flow of oil. The supply of oil to the wick is therefore entirely dependent upon the increased or diminished tension of the spring, and can only be regulated by a periodical adjustment of the stop-cock by hand. Besides this, the great friction caused by the working of the screw-spindle, tends to a considerable extent to augment this irregularity.

Another modification, wherein the same result has been obtained, is that of Mr. Wilkins of London. This lamp differs from the last, chiefly in the actuating mechanism of the piston, which in this case is depressed by a coiled spring, situated on the upper part of the lamp, working a horizontal pinion shaft, gearing with a rack formed on the upper portion of the piston-rod. The oil is supplied from the under part of the cylinder by a tube passing through a stuffing-box in the piston.



1-4th.

Mr. Meyer's lamp is the next which deserves notice. Here the oil reservoir holds the same position as in the last design, the piston being forced downwards by a helical spring, causing the oil to rise through a vertical tube, passing through a stuffing-box in the centre of the piston. As this tube approaches the burner, it contracts to a very minute bore, for the purpose of preventing the oil from rising to the burner in too large a quantity, this being the only regulator employed. It will be readily seen that the smallness of the bore of this tube, lays it open to the objection of a frequent liability to clog; and we presume that it was with a view to overcome this objection, that Mr. Wilkins, some months ago, introduced a lamp of very similar construction, in which he employs the elevating rack of the wick, to preserve the oil passage free from obstruction.

The accompanying engraving exhibits the arrangement adopted by Mr. Wilkins for this purpose; it will at the same time serve to elucidate the general principles of all the piston lamps to which we have adverted.

The oil cylinder is at A in the base of the lamp. This cylinder is fitted with a piston, B, fast upon the end of a tubular rod, C, passing through a stuffing-box in the top of the cylinder, and terminated by a cross-head, D. E, Is the helical spring resting upon the top of the cylinder, and abutting against the cross-head, D, by which it elevates the piston. In the engraving, the cylinder is represented as filled with oil, the spring being fully compressed, and the piston at the bottom of its stroke. The reactive pressure of the spring in attempting to elevate the piston, forces up a column of oil through the tube, F, opening into the top of the cylinder. The upper end of this tube is closed, but an aperture is formed at G, in the side of the rack-tube, through which the oil escapes from the tube, F, and rises through the rack-tube to the burner. Here it will be observed that the contracted oil passage at the aperture, G, answers the same end as the minute bore in Mr. Meyer's lamp. A great advantage is here gained by the shortness of the contracted passage at G, in conjunction with the contraction afforded by the presence of the rack, the motion of which, in adjusting the wick, tends to prevent obstruction. In all these varieties of mechanically-worked lamps, the leading objection of an excessive supply or overflow of oil is apparent.

In Carcel's lamp this defect has already been noticed. In the lamp in which the piston is actuated by a screw-spindle, we have seen that this objection has been sought to be removed by means of a stop-cock adjustable by hand. In the remaining examples the evil still exists, for as the initial pressure of the spring must necessarily be greater than that due to the proper height of the column of oil, so as to leave it sufficiently powerful towards the end of its stroke, it is evident that, in lamps constructed upon this principle, the overflow cannot be prevented. Another cause of variation, and one of some importance, is to be accounted for by reference to the manner in which the oil is supplied to the cylinder. This is generally accomplished by pouring it into the cup at the top of the lamp, immediately beneath the burner. In the example afforded by the engraving, the oil descends from the cup, passes between the cylinder and the outer casing, thence through an opening in the bottom of the cylinder, underneath the piston. On depressing the latter by means of a rack formed on the upper part of the piston-rod, the oil is forced above the piston, either through a valve or past its side. If, then, the lamp is filled up to the level of the cup, the column of oil contained in the neck of the lamp pressing upon the under surface of the piston, will act in concert with the spring, and thereby cause an increased overflow. This column, necessarily diminishing rapidly in height, at the same time that the spring is losing its power, must clearly increase the variation.

The only practically good arrangement which has come under our notice, wherein this difficulty is obviated, without involving an inordinate complication of mechanism, is the equilibrium lamp of Mr. Robertson, figured in plate 9 of our last volume, and described, with notes of its performance, at page 85. The oil cylinder is placed at the top of the column, immediately below the burner, the piston being forced upwards, so as to carry a column of the oil which is above it, to the burner, by a helical spring concealed in the column below, and attached to the lower end of the piston-rod. The opposite end of the helix is fastened to the bottom of the oil cylinder, and its reactive tension caused by the attempted collapsing of the coils, urges the piston upwards, and elevates a column of oil to the level of the wick, through a tube, opening into the top of the cylinder, and passing upwards to the burner. According to this brief description, it would appear that the action of this lamp differs very little from that of the several kinds previously noticed; but, in reality, the spring is so exactly proportioned to the requirements of the case, that a constant level of the oil is accurately maintained at all periods of the movement of the piston. In the first place, the spring acts by a contraction of its coils, or in a direction just the reverse of that in all the cases to which reference has been made in the present article. Thus there is no actual friction in the working of the coils, as the pull is in the direct line of the axis, without any portion coming in contact with the case of the lamp—hence one source of irregularity of motion is removed. When the cylinder contains no oil, the spring has no other pressure to sustain than that resulting from the weight of the piston and piston-rod; but when oil is supplied, this weight is of course so much increased. Having settled upon the amount of traverse of the piston, and the weight of the requisite supply of oil, a spring is to be made which shall just lose tension equivalent to this weight, in collapsing to the extent of such given stroke. This result, as is well exemplified in lamps of this construction, can be arrived at with little difficulty, and the true level of the oil is maintained without an objectionable contraction of the supply-tube; and the oil, as it is carried up to the burner, is heated considerably, thus rendering it better fitted for combustion.

Compared with Carcel's lamp, which is considered the best of its class, the balance is in favour of the equilibrium lamp, in the essential points of regularity of flame, and simplicity of action.

To follow out the subject of oil-lamps in all its ramifications, would carry us far beyond the limits of a single article; we have therefore referred only to such contrivances as are applicable to domestic purposes. The same general principles affect all others of the class, which are merely modified to suit particular purposes. We shall notice any additional improvements which may arise from time to time, and, at a convenient period, we may probably enter upon an examination of schemes for the production of the more valuable of other kinds of artificial light.

BOTANY.

SECOND ARTICLE.

Vegetable Respiration.—The sap, on being converted into *cambium*, or *latex*, in the leaves of plants is subjected to a modification analogous to that of the blood in the lungs. It is by the influence of the air that it acquires nutritive properties, for plants would die as well as animals, if placed in a vacuum, or otherwise deprived of oxygen gas. Before presenting a summary of the phenomena of vegetable respiration, we must request the reader to distinguish between the green and the coloured parts of a plant. The coloured parts are those *not green*, and the parts not coloured are those which *are green*. The *coloured* parts absorb oxygen and exhale carbonic acid (an acid in the shape of gas) both day and night. The *green* parts, during the night, absorb oxygen and exhale carbonic acid; during the day, they decompose carbonic acid, exhale oxygen, and retain the carbon. This carbonic acid proceeds from three sources: 1. from the air; 2. from the roots; 3. from the combination of the oxygen absorbed during the night with the carbon of the plant.

These facts are soon made evident. Flowers, ripe fruits, coloured leaves, roots, seeds, fungi—in short, the *coloured* parts of plants—placed under a bell filled with atmospheric air, gradually absorb the oxygen, and breathe out carbonic acid gas, and this process is continued even after death. During the night, but during the night only, the *green* parts act in a similar manner upon the air. Oxygen is absorbed, but even the pneumatic machine is unable to extract it again, because it combines immediately with the carbon, and carbonic acid results, a part of which is exhaled. During the day, and under the direct influence of the sun's rays, the green living parts give out oxygen. This oxygen proceeds from the carbonic acid which surrounds the plant. If green leaves are immersed in a glass of spring water, small bubbles will be seen to rise from it, and if these are examined they will be found to be oxygen gas, due to the decomposition of the surrounding carbonic acid. 1. In distilled water, the leaves will give out no oxygen. 2. If fresh leaves are repeatedly put into the same water, the disengagement will soon cease. 3. If the water only contains carbonates, there will be no disengagement of gas; but if a drop of sulphuric acid be let fall into it, this decomposing the carbonates, and setting free the carbonic acid, the disengagement commences.

Of twenty-one germinating periwinkles, seven were at once analysed; seven were placed under a glass, A, containing gas in which there was no carbonic acid, and seven were placed under a glass, B, containing an air with 7½ per cent. of carbonic acid amongst it. At the end of six days, during which they had been exposed to the sun, the fourteen periwinkles were analysed. Those which had vegetated under the glass, A, contained no more carbon than those which had been analysed six days previously. In those placed under glass, B, the quantity of carbon had considerably augmented. All the carbonic acid had disappeared, and, instead of 21 per cent. of oxygen, there was 24 per cent.

Oxygen proceeds also from the carbonic acid absorbed by the roots. Two branches of a raspberry plant, as nearly alike in every respect as possible, were taken, and the lower end of one was placed in an empty bottle, that of the other being placed in a bottle full of water charged with carbonic acid. The leaves of the latter branch gave out twice as much oxygen as those of the first.

The carbonic acid formed by the combination of oxygen, absorbed and combined during the night with the carbon of the plant, is also decomposed during the day by the green parts. The object of all this decomposition of carbonic acid is to obtain the carbon, which is the basis of vegetable tissue. It has been shown that trefoil absorbs azote from the atmosphere; and that the hydrogen which plants contain, sometimes is owing to the decomposition of water.

Since plants absorb carbonic acid and give out oxygen, and animals give out carbonic acid and absorb oxygen, it was at one time believed that the due composition of atmospheric air depended upon these opposite processes of respiration; but later investigations have proved, that the phenomena are incapable of modifying in the slightest degree the immense atmosphere around us.

In addition to the process of inhaling and exhaling air, the leaves of plants transmit into the atmosphere a large quantity of the water they have obtained—as much, according to some, as two-thirds of the whole quantity received. This process may be termed the perspiration of plants.

Chemical analysis has shown, that all the varieties of vegetable matter are chiefly composed of the three elementary bodies—oxygen, hydrogen, and carbon—combined in different proportions. Every plant, when the sap is flowing, may be considered as a curious chemical apparatus in full operation. Under the influence of light, heat, and electricity, the water absorbed by the roots is resolved into its constituent elements, and, combining with carbon, the oxygen and hydrogen produce wood, gum, fecula, and sugar. By a combination of hydrogen with carbon, we have oil and resin, whilst oxygen is the basis of the acids. The process of respiration, as we have seen, is another chemical operation.

ORGANS OF REPRODUCTION.—The organs of a plant designed for the reproduction of another of the same kind, when surrounded by their protecting envelope, form the flower. The flower is *male*, *female*, or *hermaphrodite*, according as it contains stamens alone, or a pistil alone, or both together. The majority of flowers are hermaphrodite. Let the reader take any common flower (the primrose, for example), and pulling away the painted flower-leaves (*corolla*), he will find within something like what the woodcut represents. In the centre is the female organ, the pistil, composed of three parts. The germen or ovary; the vessel for containing the seeds, called pericarpium, when fully developed and the seeds are ripe; this supports the styles or shaft, at the top of which is the stigma, usually set with inhaling tubercles. Around the pistil are seen a number of thread-like objects (stamens), each headed with its anther, out of which bursts the pollen, a fine powder that, falling upon the pistil, fecundates it. The shafts of the stamens are called filaments. A pistil, when simple, has only one cavity; if it contains more, it is formed by a union of several secondary pistils, called carpels, united to one another, as in the lily and hyacinth; or free, as in the ranunculus and the strawberry. The number of stamens is subject to much variety, but it is always the same on plants of the same species. The anther contains one cavity (as in the mallow), or two (as in the lily), or four (as in the Butomus umbellatus). The stamens generally open by longitudinal slits (lily, tulip), sometimes by an orifice on the summit of each division (potato, heath), and sometimes, but rarely, by valves (barberry, laurel).

Certain flowers are *sessile*, that is, growing out of the stem at once; others are supported by a stalk, called the *peduncle*, which, if ramified, the ramifications take the name of *pedicels*. We may often see at the base of the peduncle, pedicels, or flower, some small leaves, which are to the flower what the stipules are to the leaf. These are termed bracteas, and they are coloured in the Hortensia, Salvia splendens, &c. When several bracteas are disposed in a circle at the foot of a peduncle bearing several flowers, or at the foot of the flowers themselves, they form an *involucre*, as in the carrot and the dandelion. Sometimes these bracteas are united to one another, and form a small cup, like that which surrounds the base of the acorn.

The *inflorescence* is the mode in which the flowers are disposed on the stem. Axillary flowers are those which spring from the angle of a leaf, as in the common thyme. Flowers in ears are those which are sessile on the stem, or on a common peduncle, which forms the axis of the ear, as in wheat, barley, &c. Some flowers, instead of being sessile on a common peduncle, are supported upon pedicels, called a racemus, and they are then said to be clustered, as in the lily-of-the-valley (Convallaria majalis.) If the peduncles are branched, a panicle, or thyrsus, results, as in the horse-chesnut tree, or in the common oats. The corymbus is an inflorescence where the common peduncles of a racemus are lengthened out to a flat surface, as in the elder-tree. In the simple *umbel*, a number of flower-stalks issue from a common centre, like the radii of a circle, as in the hemlock. In the compound umbel, the peduncles ramify into pedicels.

The Flower.—A complete flower is composed of—1. The calyx, or cup, which envelopes the bud before bursting, and is usually green; 2. The corolla, the painted leaves of the flowers; 3. The stamens; and 4. The pistil already described. The calyx is composed of several separate leaflets, called *sepals* (as in the gillyflower, the ranunculus), or of leaflets united together (as in the pink), and it is then called monophyllate. The first kind usually falls off, the latter persists, when the flowering is over. The monophyllate calyx is often united to the pistil, as in the rose and the umbelliferous plants. Botanists look upon the flower of the tulip, iris, and lily, as only a calyx; for it is often joined to the ovary, whilst the true corolla never is.

The second envelope, the corolla, is found of a vast variety of colour. When consisting of one leaf, it is said to be monopetalous; when of several, polypetalous; the leaves being called petals. The birdweed and harebell are examples of the first, the rose and pink of the second kind. The principal forms of the monopetalous corolla are, the *campanulate* (bell-shaped), as in the harebell; *infundibuliform* (funnel-shaped), as in the tobacco plant; *hypocrateriform* (salver-shaped), as in the phlox, the tube being long and the rim flat; *tubulose*, as in red valerian; the *bilabiate* (two-lipped), as in sage; the *personate*, as in snapdragon, where the lips of a corolla with two segments are shut up. The principal forms of the polypetalous corollas are *cruciform*, four leaves disposed like a cross, as in stock and mustard; the *rose-shaped*, five petals disposed in a circle; *caryophyllate*, like the clove and pink; *papilionaceous* (butterfly-shaped), like the pea.

In addition to these parts, there are often some glandulous or filiform organs, termed the *rectarium*, the office of which seems to be to secrete honey.

Fecundation.—The pistil is not made capable of bearing seed, from which will proceed other plants, unless the stigma has been fertilized by pollen from the anthers. When a plant bears the male and female organs on the same individual, it is termed *monoicous;* but sometimes these organs grow on different individuals, and the plant is then termed *dioicous.* The date-palm is a dioicous tree: some individuals bear only male flowers, others only female flowers; and it is necessary, in order to have fruit from the latter, that branches of the trees of the former kind should be taken to them. This process, termed caprification, was well known to the ancient Babylonians. When the French invaded Egypt, in 1800, the inhabitants of that country omitted to perform this operation, and consequently the date crop entirely failed. There was a solitary female palm of this species at Berlin, which had never borne fruit. Its owner, hearing that there was a male plant at Carlsruhe, sent for some of its pollen, which was transmitted to him in a letter. Some of this powder having been sprinkled upon the female flowers, in due time they bore fruit. This impregnating operation is frequently performed by the wind, or by insects bearing pollen from one tree to another. It may be prevented taking place by cutting off all the anthers before the pollen ripens, and the flower will not then seed. Water deprives the pollen of its fecundating power, and hence, during a very wet season, the flowers of fruit trees are frequently sterile.

The means which nature has adopted to fructify the pistil are sometimes extremely curious. In most flowers the stigma is placed underneath the stamens, and the pollen falls upon it by its own weight. In many species of the stalmia, the anthers are lodged in little hollows of the corolla, and, as the flower expands, the filament is bent outwards; but after a time the anther disengages itself from its cavity, and, in consequence of the elasticity of the filament, it is projected against the stigma. Sometimes the stigma itself has a motion which favours fecundation. The two lips, which compose that of the mimulus, close together when they have received the pollen. It has been observed that many flowers, such as the arum and the caladium, give out heat at the time of fecundation, so as to raise the mercury in a thermometer several degrees.

The form of many corollas is eminently adapted to protect the pollen against rain. The superior lip of the corolla in most labials (sage, lamium), and the vexillum in the leguminous plants (bean, pea), protect the stamens like a roof.

Some flowers are termed *meteoric*, because, in flowering, they have regard to the time of day. For instance, the gum-cistus and the flax-flower open in the morning and fade in the evening; the great night-shade (nyctago hortensis) and the cactus grandiflorus open in the evening, whilst the daisy folds up at that time. Linnæus constructed a table, to which he gave the name of Flora's Clock, wherein he gave a list of those flowers which spread and shut their flowers at a given hour of the day.

In the aquatic plants, nature has recourse to many expedients to withdraw the pollen from the baneful influence of humidity at the period when it bursts from the anther. In the Nymphæa, the aquatic ranunculus, the flower elevates itself above the water before blowing; but, if sudden floods swell the lakes and streams where they grow, if the peduncle cannot elongate itself sufficiently far to keep the flower in the air, the bud swells without opening, becomes filled with air, and the act of fecundation is accomplished beneath the water. In the Vallisneria spiralis, another aquatic plant, the female flower grows on a cork-screw-shaped stem, and ascends, by untwisting, to the surface of the water, whilst the male flowers are retained at the bottom in a spathe. All at once the spathe opens, the male flower escapes to the surface, and there fecundates the female flower, which then descends to the bottom to ripen its fruit and seed.

The pollen, when minutely examined, is found to consist of grains very varied in form, but usually spherical. They are composed of two membranes, the outer one often veined like network, or set with points frequently viscous; the other very thin. In the Orchises, and some other plants, the pollen takes the form of masses of agglutinated grains. In each grain of pollen is found a liquid, named fovilla, in which small bodies float about with a rapid motion, like that of microscopic insects.

After fecundation, the pistil increases in size, the seeds it contains enlarge, generally the style and the stigma fall off, and the pistil then takes the name of fruit. In the *fruit* we may distinguish—1. The epicarpium, the outermost membrane, commonly called the rind or peel. It is often formed by the calyx, when that organ adheres to the pistil, as in the apple and medlar. 2. The mesocarpium; this fruit is not developed in dry fruits, such as the poppy. It forms the edible portion of the peach, the pear, the apple, &c. 3. The endocarpium, which immediately surrounds the seeds. It is membranous in the apple, hard and osseous in stone fruit, fleshy in the orange. Fruits are also said to be unilocular or multilocular, containing one seed (monosperms) or several (polysperms). That part to which the fruit is attached is called the placenta. Some are indehiscent, that is, they do not open; the apple is an instance. In the pulpy fruits, the mesocarp serves as soil and manure for the young seeds.

The dry fruits open either by holes (poppy), slits (silene), or valves (pea, bean). Professor Lindley classes the several kinds of fruit in this order:—

I. Simple fruits, formed of a single carpel and one cell.
    1. *Monospermalous and indehiscent*, having three subdivisions, the last of which includes the cherry, plum, &c.
    2. *Polyspermalous and dehiscent*, with two subdivisions, the last including the leguminous plants.
II. Fruits aggregated, formed of several carpels in close proximity.
    1. Carpels above the calyx, in which division are the strawberry, raspberry, &c.
    2. Carpels joined to the calyx; rose.
III. Multiple fruits.
    1. Dry pericarp, with five subdivisions.
    2. Fleshy or pulpy pericarp, with four subdivisions.
IV. Compound fruits, formed by the union of several fruits, each belonging to a distinct flower; four subdivisions.

The *seed* is a particular body contained in the fruit, and enclosing the embryo of a future plant. It is attached to the placenta by a filament termed the *funicle.* This filament is sometimes prolonged so as to form an envelope for the seed, as in the spindle-tree, and it is then called *arillus.* Mace is the arillus of a nut, growing in the tropics. The point where the podosperm is inserted in the seed, is called the *hilum.* It is broad and circular in the chesnut-tree, small and elliptical in the bean. Every seed is wrapped in two envelopes of more or less distinctness. The outer one is usually hard and dry, as in the cocoa-nut; the other is fine, and almost transparent. It is well seen in the orange. The seed, stripped of its envelopes, is termed the kernel or corculum; it is sometimes entirely formed by the embryo, as in the bean. In other plants, it is formed of the embryo and albumen, a substance which is farinaceous in wheat, oily in the castor-oil plant, saccharine in the cocoa-nut. The embryo consists of four parts: the radicle (rostellium), the small stem which bears one or more primordial lobes or leaves, called *cotyledons.* These cotyledons are scattered and fleshy in seeds deprived of albumen (bean, chesnut); thin and foliaceous in those which have only one (maple); lastly, the plumula, which shoots upwards and becomes the stem.

In order to germinate, it is necessary that the seed should be fecundated and become ripe. Some seeds will only germinate within a short time of their being gathered; these are chiefly those with oily albumen. Others will grow after being kept for any length of time. Grains of wheat found in Egyptian tombs, where they had lain upwards of 3000 years, germinated and produced seed when planted. Several things are indispensable to germination: 1. Water, which softens the outer case, favours the escape of the embryo, and dissolves the nutritive parts. 2. A proper degree of temperature. 3. Air. A seed will not sprout in vacuum, nor if buried too deeply in the ground. During the process, oxygen is absorbed and carbonic acid given off. The time of germination varies considerably: common cress, for instance, will germinate in a day or two, whilst the seed of the rose requires two years. The fact is announced by the rupture of the external envelope, and then the radicle appears. Whatever be the position of the seed, the radicle is invariably directed towards the centre of the earth, whilst the plumula mounts upward. Some seeds having been placed in the trough of a wheel, which was made to revolve rapidly in the air, it was found, when they had germinated, that all the radicles were directed towards the circumference, so that this part of the process would seem to be performed in obedience to the laws of gravitation. Plants have a strong desire for light, and they will be found, if growing in a room, to make towards the window. Trees always send out branches in the direction where there is most light, and hence the outer branches of trees in avenues are much the finest. The experiment has been tried of placing plants in a cave, with orifices, some of which admitted air without light, and others, being glazed, light without air; and it was found that they grew towards the latter.

CHAPLIN AND DIXON'S DOUBLE-ACTING LEVER WINCH FOR SHIPS.

This is a simple apparatus, intended chiefly for ship's use, to facilitate hoisting operations at sea, as in raising top-mast yard-arms or spars. It furnishes an efficient power of easy regulation, and may be attached to any convenient part of the ship, so as to obtain the best command over its work.

Figs. 1 and 2 exhibit, respectively, a front and side elevation of the apparatus. A A, Are the bitts of the ship, to which are attached a couple of bearings, B, to carry the cross shaft, C, of the barrel, D, for the rope. A ratchet-wheel is cast upon the inner end of the rope barrel, D, and into the teeth of this, two palls, working on studs in the interior of the lever socket, F, are set so as to work in either direction, accordingly as one or other of them is left in gear, and an additional detent, separately attached to the bitt, prevents the return of the barrel at each return movement of the lever.

Fig. I.

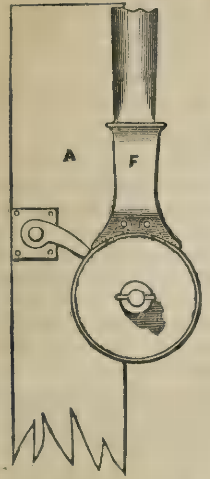
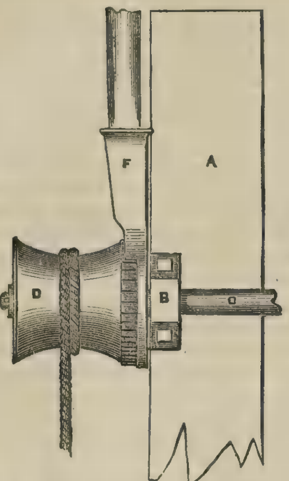


Fig. 2.



A single man is capable of working this winch, both in heaving and in taking up the slack, an advantage unattainable in the ordinary handle winches.

ELECTRO-GILDING AND PLATING IN SCOTLAND.

The art of coating metallic articles with a thin film of gold or silver, exhibits one of the most perfect of the practical applications of the chance discoveries of scientific men. In the hands of close observers, the deposition of a metallic coating from the sulphate solution in a galvanic battery, has been worked up into a valuable branch of industry, the extent of which it is impossible to define.

Up to a late period, Birmingham, as the seat of the metal manufacture, has almost entirely monopolised the working of the process, but we are glad to find that our own immediate neighbourhood is beginning to feel the benefits arising from its introduction here.

Under the title of the West of Scotland Electro-Gilding, Plating, and Refining Establishment, an excellently arranged building has been erected at the head of Buchanan Street, and the several processes abovenamed are now being carried on under the experienced management of Mr. S. Coleman, Jun. As the commencement of a trade which may be said to be new to the country, the trial is worthy of remark; and more especially when it offers so many points of interest as attach to every step in this philosophical pursuit.

Although on so small a scale, we find that all the different classes of work ordinarily to be found in the older establishments of the south, are here successfully carried on, and from the rough white metal bodies—the modern substitutes for solid silver—electro-plated articles are produced in a style of finish befitting their future standing. The processes of re-plating and gilding present, under their various forms, beautiful examples of applied science; and in the latter, the instantaneous nature of the operation is of itself a curious fact.

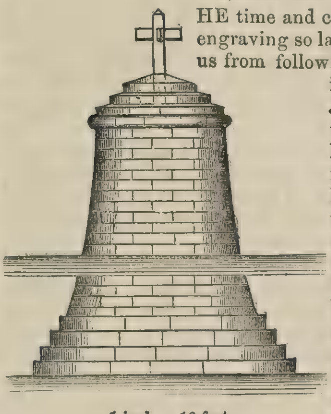
The immense superiority of electro-plating, as compared with the old system, demands no confirmation at our hands. Not only does the precious coating adhere more closely to its baser ground, avoiding all risks of cracking and deterioration of surface, but the deposited film being absolutely pure, produces a surface unapproachable in beauty by any other contrivance. The refining of the precious metals is also here carried on under various conditions. This is one of the most interesting of metallurgical processes, and deserves a treatise for its exposition. In a future page, we may be able to contribute something towards this end.

It is to be hoped, that the advantages to be derived from this extension of the manufacture may be properly appreciated by the public, and by the parties engaged in the numerous branches of trade which it affects. So spirited an attempt on the part of the proprietor, Dr. F. H. Thomson, adds weight to the claims for attention, which, as a scientific pursuit, the business in itself demands. Looking at the invention in the light of an industrial pursuit, we cannot call to mind any improvement of the present century which has spread so rapidly in practice—and this fact is undoubtedly the true criterion of its value. The general principle of the art is now so well understood, that further remark would be superfluous; any of our readers who wish to witness the actual working of the system, may find many attractive features in the establishment whose existence we now chronicle.

THE RIVER CLYDE.

Harbour and Railway Improvements.

(*Illustrated by Plate* 29.)



1 inch = 16 feet.

THE time and care required for the execution of an engraving so large and elaborate as this, prevented us from following up our intentions in producing it in time for the last number of the *Journal;* but we have made use of the additional time obtained by delaying it, in making it more satisfactorily complete, by the addition of local references, and a fourteenth section of the river wall. The view of the river extends from the head of the new south wall at Clyde Terrace, in the upper harbour, immediately below Stockwell Bridge, down to the mouth of the lower of the two Stobcross Docks. A little below the upper limit of our plate, it is proposed to erect a suspension bridge to accommodate the foot passengers from the populous suburb of Portland Street and neighbourhood, on the south side of the river, in passing into the city by way of Maxwell Street, to join which two streets, it is to be set at a considerable angle with the curve of the river, as shown. A design for this bridge by Mr. George Martin is now before us. It represents a handsome structure of a single span of chains carried by two stone towers, one on each bank; the clear width between being 410 feet. The foundations of the quay walls and towers are to be on timber piles, 12 feet long by 8 inches diameter in the middle, set at 3 feet apart from centre to centre. The heads of these piles have pine sleepers bedded upon them, and the space round the pile heads, and between the sleepers, is filled up with rubble set in hydraulic mortar, and across and at right angles to these sleepers, a timber platform, 4 inches thick, is spiked down. The outside of the faces of the tower foundations and the quay walls, are also cased with sheet piling.

The towers are of rusticated ashlar, surmounted by a neat pediment, to carry the light cast-iron saddle-plates for the main chains. These chains are set in two rows on each side, the upper row having three links in the chain, 10 feet long, from centre to centre, 4 inches deep, and $1\frac{1}{4}$ inch thick. The lower chains consist of four links or bars of the same length and depth, and 1 inch in thickness. The coupling links for the upper chains are four in number, 10 inches from centre to centre, $6\frac{1}{2}$ inches broad, and 1 inch thick. Those for the lower row are five in number of the same dimensions. The suspending rods are of a section 1-inch square; they are fixed to the upper main chains by $1\frac{1}{8}$ inch bolts, and to the lower series by $\frac{7}{8}$ inch coupling links.

The roadway is intended to be about 23 feet above high-water mark, and to be 15 clear feet in width. It is supported by 85 cast-iron beams, 16 feet long, 1 foot broad in centre, and 8 inches at each end, and 1 inch thick; and upon these is carried the roadway of 3-inch planks.

It is to be hoped that this project, about which some uncertainty still exists, may be carried out at an early period, as the removal of the old wooden accommodation bridge from the same site, has caused an inconvenience to the residents in the locality, only to be remedied by some similar substitute.

Below Glasgow Bridge, the large area of Windmill Croft, on which the dock of the same name is represented in our plate, is yet unbroken ground; probably, when the cut at Springfield, and the several other heavy works are completed, this dock will be executed so as to provide the additional accommodation for vessels, now so much required. The extent of the improvement proposed to be effected below the Springfield wall, is represented by the large expanse on the inside curve of the river at that point, which is cut off by the strong dotted line stretching from the lower end of this wall down to the sharp bend below, opposite to the lower Stobcross Dock. The bulk of the earth cut off by the new Springfield quay wall still remains, but the works here are rapidly approaching completion, when the river will receive the full advantage of the greatly increased width shown in our plate.

Of the four cranes marked, as fixed down at this wall, one of the two driven by steam power, constructed by Messrs. Yule and Wilkie of this city; and one of the hydrostatic cranes, constructed by W. G. Armstrong, Esq. of Newcastle, are already in their places. The boiler for the former of these is placed just inside the wall of the General Terminus Railway Company, the steam being conveyed in a pipe passing underground, to a small horizontal direct action high-pressure engine, driving a horizontal shaft, gearing with the central shaft of the crane. The hydrostatic crane is worked by a pipe taken directly down to it, from the mains of the Gorbals Water Company. Both are found to work satisfactorily, and we have arranged to give views of them in future plates.

The single line running parallel with the quay wall exhibits the line of rails for the discharge of waggons into the ships alongside the wall. It communicates by turn-tables with the series of branches diverging from the double line passing down from the Polloc and Govan branch, beneath the road leading to Paisley. The sharp lines represent those already executed; the dotted ones such as are yet to be laid down. The Stobcross Docks, referred to in a previous article, are here clearly exhibited. The entrance dock opens directly into the river by a short passage, and its level of water will, of course, be subject to all the variations of the river; but the entrance of the second dock is guarded by a lock, so as to preserve a due depth of water at all times.

The several sections of walls afford examples of various systems of construction. No. 1 extends from Glasgow Bridge down to the ferry stair at the foot of York Street, on the north side of the river, and was built in 1828-9 under the management of the trustees. One section is taken through the timber wharfs for the accommodation of the river steamers, two of which were erected from Mr. Bald's designs in 1842. About 120 feet of this wall gave way in 1832, and was rebuilt by C. Atherton, Esq. The foundation piles are set 3 feet asunder in plan, and the whole river front is defended by sheet piling. No. 2 extends from the termination of the last section at the foot of York Street to Royalty Burn; it was designed by Mr. Rennie. This has given way at several times. A portion of it was renewed in 1842 by Mr. Bald, according to section No. 3. No. 4 extends from the ferry stair at the foot of Clyde Street to the recess at Hyde Park. It is similar in construction to No. 1, with additional length of piles. It was built in 1831. No. 5 extends from the Royalty Burn to the foot of Clyde Street. It was erected from Mr. C. Atherton's designs in 1832. It stands on three rows of piles of home-grown timber. No. 6 stands opposite Hyde Park. It was built in 1838-9 from designs by Mr. Logan. It is founded upon four rows of Quebec red pine, set 4 feet asunder in the length, and 3 feet wide in the row. No. 7 is opposite Lancefield. It was built in 1845 from Mr. Bald's designs. The foundation consists of four rows of Quebec red pine piles, filled in at the top with concrete. This wall has counterforts placed 12 feet apart. The piles are 3 feet apart, both in the length and in the row. No. 8 is the Windmill Croft quay wall. It was commenced in 1835, and finished in 1838, from the designs of Mr. Logan. About 170 feet of it, west of the upper ferry stair, gave way, and was rebuilt in 1846, from a design by Mr. Bald, according to the design No. 9. The front row of foundation piles is set 2 feet 6 inches from the inside of the sheet piling; the remaining ones are 3 feet apart each way. In this figure is shown an elevation of one of the rectangular piers used for carrying the shed columns. The piles are set 3 feet 8 inches wide in the row, and 4 feet asunder. No. 10 extends from Glasgow Bridge to the foot of West Street, on the south side of the river. It was built in 1837 from Mr. Atherton's designs; and a portion of it failing in 1838, was rebuilt, according to No. 11, by Mr. Logan. No. 12 is the north quay wall opposite Carrick Street. It is fronted with long piles placed 4 feet apart, and supporting one side of the timber stage, the top of which is formed of half timber joists, planked over. No. 13 is the new Springfield quay wall, just erected. The footing course of this wall is carried on a substratum of 3-inch planks, 12 inches broad, laid in sand, at 3 feet from centre to centre, in the row. No. 14 is the Finnieston wall. It is carried on five rows of piles, covered on each side with sheet piling. No. 15 is the Springfield wall, on a larger scale, showing the mooring palls now being put down at this point. For the general details of these walls the figures afford their own explanation. In the steam-boat waiting-room, erected at Glasgow Bridge, is an ingenious apparatus, combining a rain-guage, anemoscope, anemometer, tide-guage, and barometer, all of which are self-registering. This arrangement we shall shortly have an opportunity of illustrating.

In concluding this brief notice of these most extensive works, we have to remark, that all the credit attachable to the improvements therein worked out, as connected with the immense public, we may say national, benefits they have conferred, is justly due to the shrewdness, energy, and enterprise of the merchants of Glasgow, and to them alone. Of the present Board of Trustees, the Hon. James Anderson, Lord Provost of Glasgow, is chairman, and David Chapman, Esq., the extensive steam-boat proprietor, is deputy-chairman. It is almost unnecessary to say, that in the works now successfully being carried out, this Board shows itself to be in every respect worthy of Glasgow and of the Clyde.

CONSTRUCTION AND DECORATION OF PUBLIC BUILDINGS.

The Prince's Theatre Royal.

The increased care bestowed upon the decorations of places of public resort, is now becoming more and more marked, giving note, not only of an improving taste on the part of the public, but of a healthy desire to lead and extend the tone of that taste, on the part of those to whom we have to look for novelty in ornamental art. In place of the overweening superfluity of colour and details, of which the older class of decorations are such flagrant examples, the growing purity of taste now leans more towards the elegance of simplicity, and a purpose-like arrangement and fitness of parts, for the offices they are to fill. The style of the internal decorations of the New Prince's Theatre in this city, affords one of the best examples of this change for the better; and this alone, without reference to the fact of so great a novelty, as the erection of a handsome structure of the kind in Glasgow, is sufficient to demand a recording notice from us.

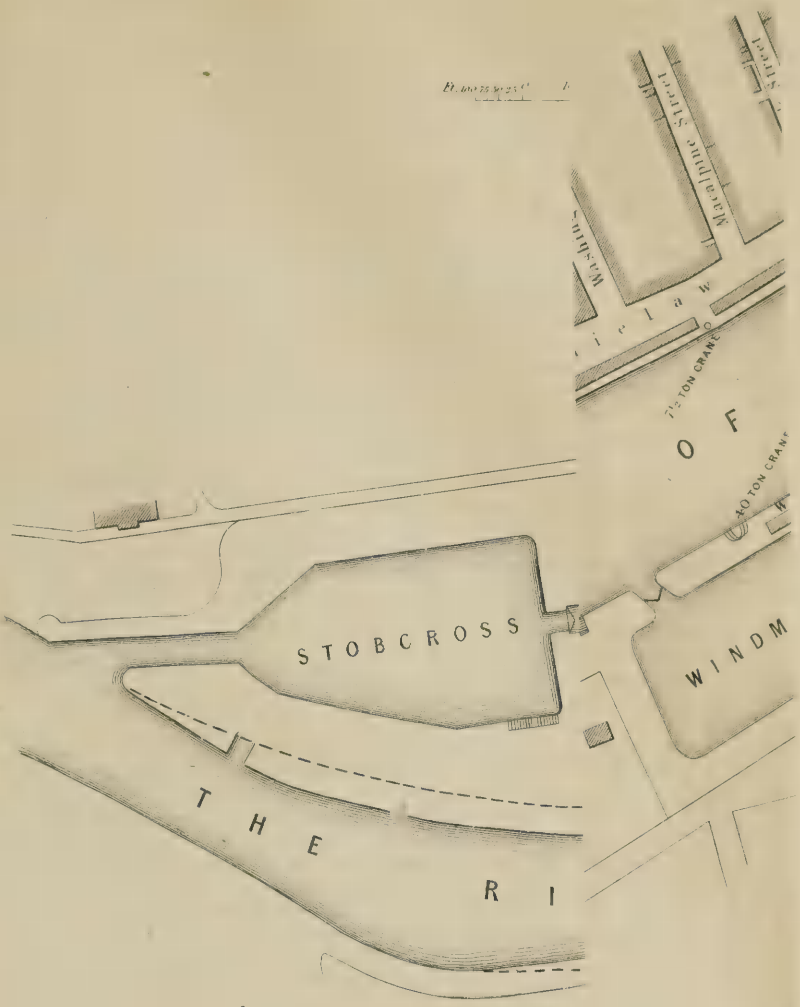
The building, which is partly a conversion, is situated in West Nile Street, or rather, between that street and the upper portion of Buchanan Street, from both of which entrance can be had to it. It was originally fitted up as an exhibition-room for some of Daguerre's dioramic pictures, but with the view of extending its chances of usefulness, it was so constructed as to be capable of being turned to advantage in the way of a public hall, of which the locality is destitute. It is well that this provision was made, otherwise the present purpose of the building could not have been so easily served. The box and gallery tiers are supported upon beams 9 inches square, formed of eight thicknesses of timber set on edge, so as to produce the requisite curvature. By this mode of construction, a very strong and tough beam is obtained. The internal shape of the house is that of a wide horse-shoe, the pitches of the different tiers being well arranged for obtaining a clear view of the stage.

Over the centre of the pit, a large ventilator is fixed in the roof; it is in the form of a chamber erected above the roof, just above the opening into which is set a sheet-iron shield, about 10 feet in diameter; against this the upward current of heated air, from the gas-pendant below, strikes, and accelerates the escape flow of air, which passes round the edge of the shield, by a recess in the ventilator chamber, whence it finds an exit near the top. Considerable skill has been shown by Messrs. Laidlaw & Son in fitting up the gas-lights. Two 1½-inch pipes pass round the edge of the stage, having argand burners set at 6 inches apart on each pipe, ranging alternately, so that the actual space between the lights is 3 inches. The burners on the outer pipe have green glass shades for use in moonlight, or other representations; the inner ones have the ordinary colourless ones. In the wings and borders, all the lights are well protected by hoops, to prevent the risk of accidental contact with the dresses. The arrangements for managing the lights are at the prompter's seat in the left wing; and we observe that a plan has here been put in force, whereby the gas cannot be accidentally shut off altogether, by fixing additional small pipes behind the main stop-cock.

The ceiling is formed of dense canvas, which appears to be most effectual in assisting the propagation of sound. The various accidents from fire, which have recently occurred in buildings of this class, have led to a more strict supervision in this respect, and certainly here, all precautions appear to have been taken. Arrangements are made in the tiers for obtaining a communication all round the house; and, what is of great importance, all the doors which shut the various lobbies during performance open outwards. A standing-main of water at a high pressure is carried round behind the pit, boxes, and gallery, with a hose and nozzle to each; and from a cistern on each wing-platform, a hose is carried for the supply of a portable fire-engine on the stage.

The decorations which, at a glance, express the admirable taste of the manager, Mr. Edmund Glover, are the production of Messrs. Jackson of Rathbone Place, London. They are in *carton-pierre*—most of them in very high relief—forming festoons of fruit, flowers, and panels, the latter with groups of children. On the box front, carried by brackets in a line with the pillars, is placed a beautiful orchestral group; and over them again, in the gallery front, are termini, with brackets supporting gas-lustres. The backgrounds in the panels are pale blue—the enrichments white, picked out with gold, and the tier-fronts are rose-colour.

The corridor, by which entrance is gained from Nile Street, is spacious,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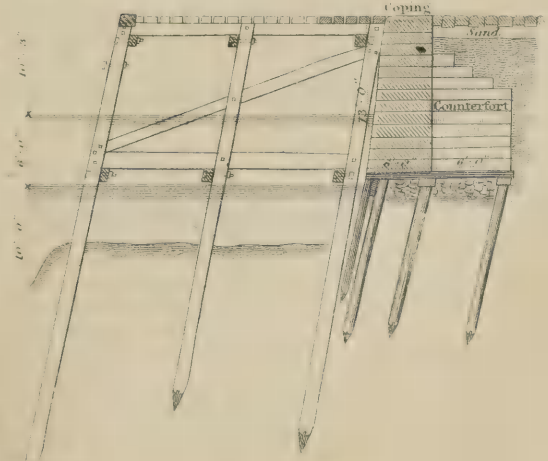
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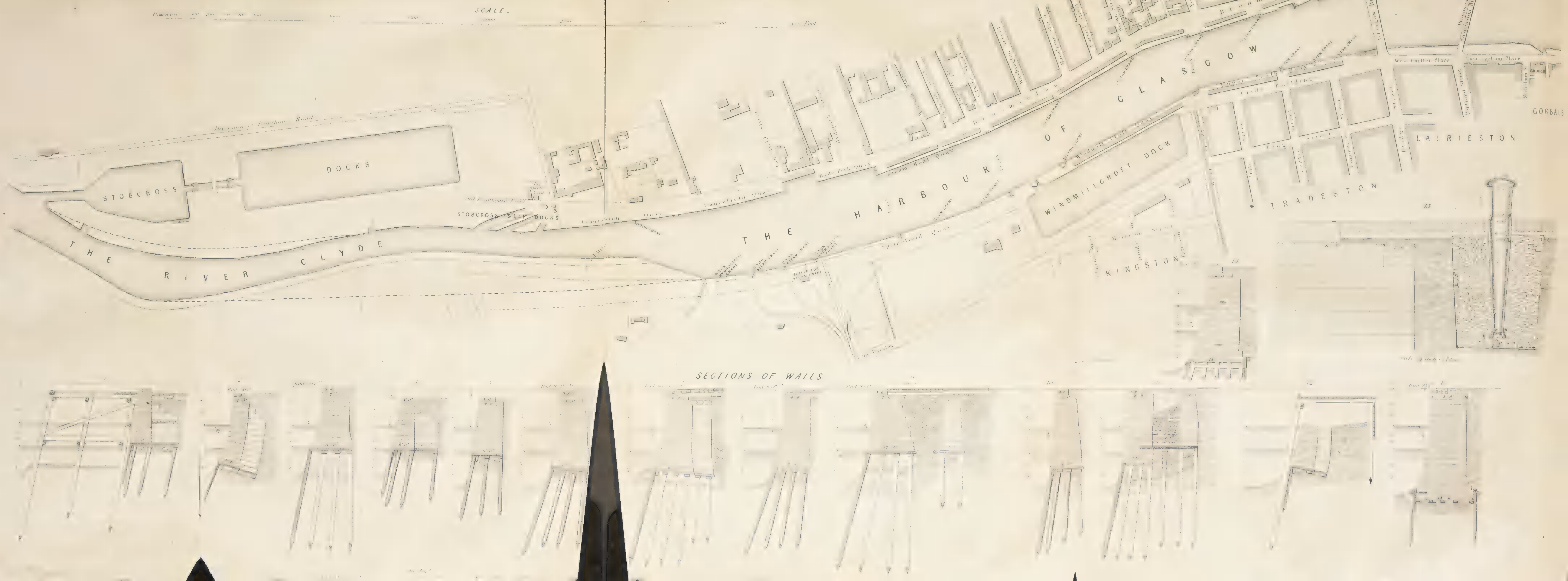
GLASGOW HARBOUR, WITH THE PROPOSED DOCKS.

1849.



and is painted in cool tints, with here and there prominent figure groups on brackets. The ceiling over the pit presents many beauties of colour and composition. Its general tone is a dark blue, laid out in panels, with wreaths of flowers, and over the proscenium is a group of dancing boys. The gas pendant, which forms a prominent object, is suspended from ribands held by three cupids, the whole giving an elegant air of lightness.

Nowhere have we seen greater attention paid to the scenery than is here evident in every part. Several of the scenes are by Mr. Glover himself, who adds rare talent as a painter, to his better-known stage accomplishments. We may refer to one representing the front of a country inn, near which is a water-mill, driven by a mountain stream, with a rocky and uneven foreground. As an artistic effort, this production possesses many points of excellence—the eaves of the inn gable, for example, present an amount of projection quite remarkable, as produced entirely from the flat, and the rocks and broken ground in another portion are true imitations of the massive formations of nature. The remainder of the paintings, by Messrs. Bough and Hawthorn, exhibit many excellencies. Of the act-drop scene by Mr. Bough, various opinions have been expressed. Its subject is the same as that of the celebrated picture by Nasmyth, painted for the Queen Street Theatre, but under a totally different treatment. The view is taken from near Old Kilpatrick, on the north side of the Clyde, of which it gives a fine expanse, including Erskine Ferry, Bowling, and in the distance, Dumbarton Castle, with the ruins of Dunglass, and the memorial here erected to the unfortunate Henry Bell. As a whole, the work promises much for the future exertions of the young artist.

In thus briefly noticing so spirited an undertaking, it is due to James Lumsden, Esq. of Yoker, to state, that to him, as the proprietor of the building, the public are indebted for so efficient an attempt at the restoration of the declining fortunes of the drama, as is afforded in the Prince's Theatre.

RECENT PATENTS.

ELECTRO-MAGNETIC ENGINES.—Soren Hjorth, London.

Enrolled April 26, 1849.

This invention relates to certain improvements in the use of electro-magnetism, and its application as a motive power for general purposes, and also to certain improvements in the application of electro-magnetism to engines, ships, and railways.

In this specification, the word "magnet," unless otherwise defined, is used generally to signify either a permanent magnet or metal, or other substance made magnetic by a current of electricity.

Fig. 1.

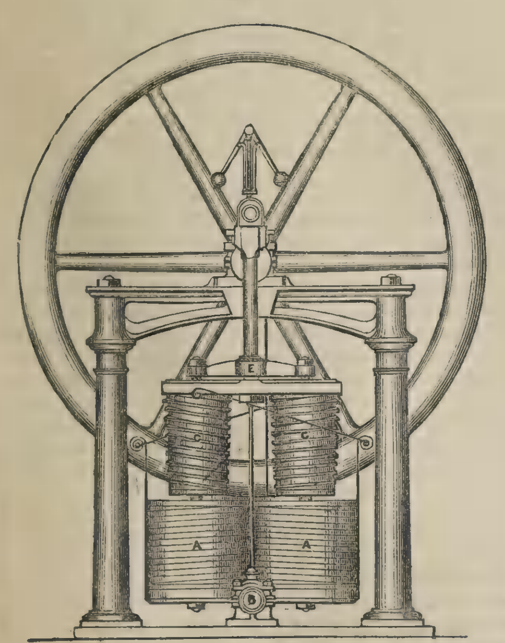
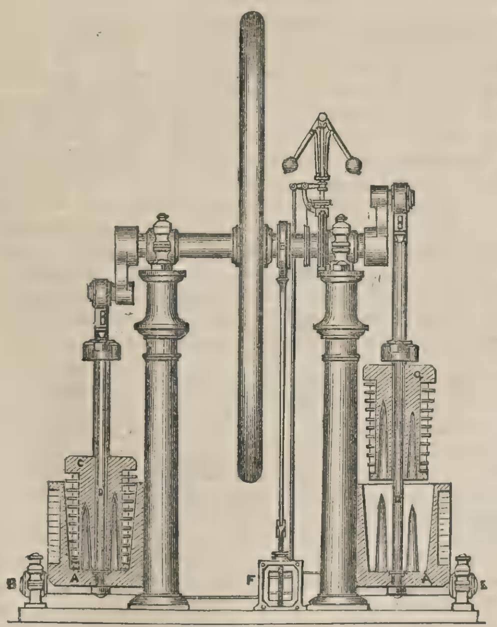


Fig. 2.



The improvements in the use of electro-magnetism, and its application as a motive power for general purposes, relate to a mode of obtaining such power by the reciprocal or rotatory motion of magnets, or electro-magnets.

The invention consists in obtaining such power by means of magnets, or electro-magnets, both fixed and moveable, formed and arranged in such a way, that during the motion of the moveable magnet, or magnets, separate points or parts of the surface of the moveable magnet, or magnets, or metallic armatures, or the poles of the several moveable magnets, shall be brought separately and successively to act upon, or be acted upon, by the separate points or parts of the surface or poles of the fixed magnet, or magnets, or metallic armatures, and so that the attraction or repulsion of one point or part of the surface or pole, shall be followed up by the attraction or repulsion of another point or part of the surface or pole, so that a rotatory or reciprocal action may be obtained, and sustained over a greater length of stroke or circuit, than by the simple action of magnets, or electro-magnets, arranged in the ordinary manner.

Fig. 1 represents the elevation of an engine made on this principle; and fig. 2 a section of the same engine. A A, Is a horseshoe-formed hollow magnet, conical on the inside, coiled with copper or other wires, and suspended in such a way that it oscillates on the centre, B, with suitable bearings and plummer blocks, as shown in the figure. In the interior of this magnet is fixed a number of conical rods of different lengths. C C, Is another horseshoe-formed magnet, conical on the outside, with apertures corresponding to the conical rods in the magnet, A A, and likewise coiled with wire. This magnet moves on the guide-rods, D D, which are connected together at the top by means of the cross-head, E, and fastened at the bottom of the magnet, A A. The guide-rods may also be fixed to the magnet, C C, and guided by rollers. A connecting-rod is attached to the magnet, C C, in the centre, driving a fly-wheel shaft by cranks in the usual way. O, Is the commutator to change the electric current as required, which is similar in its mode of working to the slide-valve of a steam-engine, and moved in a similar way by an eccentric and eccentric-rod. The action of the engine may be reversed by the use of a supplemental eccentric. The governor serves to regulate the proper supply of the electric current to the commutator, O, as afterwards described.

The current, after being regulated by the governor, is introduced through the commutator into the helix of wires coiled round the magnet, A A, and thence through the conducting wires to the helix or coil of wires surrounding the magnets, C C, and thence through the conducting wires to the battery, or by the reverse course, as may be found convenient. As soon as the electric fluid from the batteries passes round the magnets, they exercise their power by a mutual attraction, not only in the ordinary way, but in consequence of the magnets being so shaped that the inside part of the outer magnet, as well as the outside part of the inner magnet, forms angles with the direction of motion of the moving or working magnet; and, at the same time, rods of different lengths presenting themselves at the poles of the respective magnets, the attractive power is sustained over the whole stroke by successive points and successive parts of the surfaces being brought to act upon one another during the whole stroke. When the stroke in this manner has been made by one set of magnets, the current is changed, and the other set of magnets are made effective by the current passing round them in the same manner as before described. In order to prevent the current from being broken, and also to check the momentum of the magnets, the slide in the commutator, O, is made so long that it does not leave the conducting surface which communicates with one set of magnets, until it has reached the other, communicating with the other set of magnets.

By the arrangements above described, a reciprocating motion is obtained similar to that of the common oscillating steam-engines, and it will be obvious that a motion may be obtained similar to that obtained by any of the various forms of steam-engines by suitable adaptations of beams, rods, cranks, &c. Thus it may be carried out as a single or a double acting engine, as an ordinary beam engine, or as a direct action engine, according as it may be required for stationary, locomotive, or marine purposes; and in all cases its form may be varied according to the circumstances of the case.

Figs. 3 and 4 represent, on a larger scale, the apparatus for regulating the current. Its action may be readily understood from the figures. The most convenient form is a forked piece of metal, with two wedge-shaped prongs sliding along two parallel surfaces. The current from the battery passes, as indicated by the small arrows in the figure, from one of the parallel surfaces through the wedge-shaped fork to the opposite surface, and thence to the commutator; and the current will pass with greater or less intensity, according to the amount of the communicating surface given by the larger or smaller part of the wedge. The particular form is immaterial, so that taper pieces of metal are used, which, by the ordinary action of the governor, may give greater or less communicating surface.

Fig. 3.

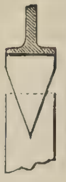
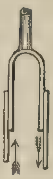
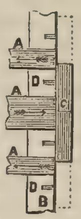


Fig. 4.



The commutator is shown in fig. 5 on a larger scale. This apparatus consists of three metal surfaces, A A A, placed in a non-conducting medium, such as wood, B. The metal surface or slide, C, is shaped and moved in such a way as to conduct the electric fluid according to the motion of the engine alternately from the centre surface, which is connected with the battery to either one of the other and outer surfaces, which are connected respectively with the coils of the two sets of magnets. The slide, C, is made sufficiently long to be always in contact with one or other of the surfaces connected with the magnet coils; and by the adjustment of this length and of the eccentric, any required "lead," as it is termed in steam-engines, may be obtained; D D, is black-lead, which may be let into the insulating medium to facilitate the conduction, and, at the same time, to act as an anti-friction.

Fig. 5.



The whole apparatus or commutator may be enclosed in an air-tight box, with a glass lid or cover, the slide-rod working through a stuffing-box. Where large batteries are required for producing sufficient quantity of electricity to work powerful engines, a compound commutator, or several commutators, may be employed, each being connected with a certain number of cells, and a certain number of coils. By this means the destruction of the conducting points of the commutator will be avoided, the governor may act so as entirely to detach one or more of the commutators, and so throw off the cells of the battery communicating with such commutator.

We shall give the remainder of the specification, with additional details, next month.

SEPARATING DIFFERENT QUALITIES OF POTATOES.—

James Anderson, Glasgow.—*Enrolled May* 11, 1849.

Mr. Anderson has, in this patent, ingeniously turned to account the ascertained fact of the variation of the specific gravity of the potato and other vegetables, in nearly strict agreement with the relative economical value of their substance. Experiment has shown that a potato containing about 20 per cent. by weight of solid nutritious matter, is of a specific gravity equal to 1·080; or, in other words, it will sink in a liquid of a density of about 16° of Twaddell's hydrometer, and one of a specific gravity of 1·120 will sink in a medium having a density of 24°. As a general rule, potatoes vary in specific gravity from 15° to 24°; the patentee, therefore, prepares a liquid of such a density as he may require, by the addition of salt, clay, or other substance, and in this liquid he places the roots to be assorted. When thus treated, the heavier class at once fall to the bottom of the liquid, whilst the lighter or inferior kinds float, affording an easy means both of testing the commercial value of a given parcel of roots, and of effectually separating the various qualities in large quantities.

The claim is—the system, method, or process of assorting, separating, or dividing potatoes, and other roots or vegetables, into different classes or qualities, according to their ratios of specific gravity, by the use or means of a liquid or liquids, the specific gravity of which is in accordance with that of the separate or different classes of roots which may be required to be obtained, in whatever manner, or by whatever means, the same may be applied or put in practice.

COPPER AND OTHER METALS.—A. & H. Parkes, Birmingham.

Enrolled May 11, 1849.

The patentees' plan, as far as it refers to copper, consists in calcining the carbonates or oxidized compounds of the metal, either alone, in a calcining furnace, or in combination with an acid or alkaline substance or their salts, or with sulphuret of iron, or other sulphuret, excepting that of copper, to facilitate the subsequent process of reduction. The compounds of copper are ground previous to being thus operated upon. Some of the foreign matters may be removed simply by calcination; but when arsenic or antimony is present, it is proposed to use muriate of ammonia, or chloride of barium or calcium, in the proportion of 1 to 1½ parts to the arsenic or antimony in the compound. The compounds are placed in the furnace with their purifying agents, mixed with their own weight of carbonaceous matter, the mixture being rubbled from time to time, during the operation, which lasts from three to five hours.

In obtaining copper from the carbonate or oxidized compound, containing not more than 10 or 15 per cent. of metal, it is converted into a sulphuret to facilitate the separation of the earthy matters from the regulus. Sulphur, or the sulphuret of lead, zinc, or iron, is used for this purpose. In using sulphur alone, a quantity equal to one-fourth of the copper contained in the compound is added. It is proposed to employ currents of steam or air, or other vapour, impinging upon the surface of the compound in the reverberatory or blast furnace, to expedite the process.

In operating upon sulphurets or carbonates of lead, one part of sulphuret of lead is added to two parts of the carbonates or oxides, fusing the mixture in a reverberatory furnace, thus obtaining metals from both compounds. With carbonates or oxides of copper, stearates or oleates of lime, calcium, baryta, or any gum, resin, or fatty matter, are to be used, or the sulphurates of copper, the chlorides of sodium, calcium, magnesium, or strontium. Another branch relates to the obtainment of an alloy of copper and zinc, by operating upon the carbonates and oxidized compounds of these metals—100 parts of copper compound are added to 75 of zinc, containing the same per centage of metal, and fused together. Again, in alloys of metals, phosphorus is combined with copper, zinc, tin, or lead, or alloys of these metals. The patentees give a series of compositions of this kind, varied to suit different purposes.

The specification is simply descriptive, and contains no claim.

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GOVERNMENT PATRONAGE OF INVENTORS.

An inventor's petition to the House of Commons, bearing the signature of A. H. Holdsworth, Esq. of Dartmouth, is now before us. The case presents features not ill calculated as an illustration of that neglect of just claims, for which the nation, or rather its authorities, have become famous. Mr. Holdsworth, who, himself, held a seat in the House for nearly thirty years, has, from an early period, bestowed considerable attention upon mechanical pursuits—and, amongst other points which engaged his attention, that of fire-proof and cooling bulkheads for men-of-war and steamers, became, in his hands, a matter of deep investigation; and in 1842, he patented a plan of water-tight bulkhead, equally applicable as a means of prevention of the dangers of explosion of powder magazines, as for the absorption of the excess of heat in stoke-holes. For the latter purpose, his invention was adopted at this time in the "Victoria and Albert Yacht," and in 1843, having failed in his attempt to prevail upon the Board of Admiralty to fit it up in the government steam-sloop "Cormorant," he, with their permission, put it in himself, when the vessel was in preparation for a cruise in the South Seas, and thus tested the value of the scheme as a safeguard against the effects of a tropical climate. Subsequently, in order to satisfy the Board as to the security against fire, afforded by such bulk-heads when arranged for the purpose of a magazine, he constructed a magazine on his principle, and exhibited it on a wharf at Cannon Row, charged with inflammable materials, and surrounded by a strong fire. This trial was witnessed, and its favourable result evidenced, by the Comptroller of Steam Machinery, Sir Edward Parry, and others connected with the naval service. When thus ascertained, the inventor, to quote his own words, placed the invention under their protection, in the hope that, while they were further assured of the advantage conferred by it, a proper remuneration would be awarded to him. Vain hope! All the acknowledgment vouchsafed to him was embodied in a short communication, to the effect, that their lordships felt obliged for the trouble he had taken to benefit the service, and declining proceeding further until they should receive reports as to the success attending the experimental trials on board the two vessels before-mentioned. A fresh delay then occurred—ended by the favourable report of the engineer of the royal yacht, which procured an order for the fitting of the bulkheads to six new iron steamers.

Had we been in Mr. Holdsworth's position at this period, we should doubtless have deemed our plan secure of a remunerative introduction; for surely the application of it to six steam-vessels would never have been sanctioned, had it not been found worthy of general adoption in the eyes of the practical advisers of the Admiralty.

In 1844, the bulkheads were fitted to the "Trident," under the inventor's superintendence; yet, after all these tests, when his request for compensation for the use of his patent right was preferred, his proposals were rejected altogether on the ground of excess of charge, although the introduction of the system was not discontinued. On the plea of obtaining additional reports in the matter, the vitally important point of remuneration was continually deferred, until, in 1846, when the "Sidon" was ordered to be fitted in this way, and the matter was again broached. In July of the year following, it came out that, during a short trial of the "Avenger" steam-frigate, at Spithead, the thermometer actually rose to 143°; and, in consequence, Captain Dacres, then commanding this ship, at once applied for the apparatus. This application was unheeded, and it is recorded, that afterwards, when sent to Lisbon, the heat increased to 160° when the engines were in full work.

In 1848, three years after Mr. Holdsworth, at the request of the Admiralty, proposed terms for a license, an offer was made to him of 5s. per horse power for vessels already fitted, and 2s. 6d. for all to be fitted thereafter, at the same time requesting him to name the vessels on behalf of which he claimed remuneration. As the plan had been by this time so freely introduced, it was hardly to be expected that any one not connected with the service could take upon himself to state exactly what vessels had received the bulkheads; and such an offer made to the inventor himself, comes with a peculiarly ill grace from the unlicensed users, and those users the governing heads of the marine service of the nation.

In this way the matter now stands, offering plain hints on the danger of trusting to the rare chances of government patronage, or the promises of bodies who shroud themselves under the plea of irresponsibility. The value of the bulkheads admits not of an atom of doubt—the inventor's prospect of remuneration is overshadowed by too many.

THE NEW CLOCK FOR THE PALACE AT WESTMINSTER.

When it was determined to effect the restoration of the old clock tower, in rebuilding the Palace at Westminster, applications were made to three of the most eminent clock-makers of the country—Mr. Vulliamy and Mr. Dent of London, and Mr. Whitehurst of Derby—for specifications of such a clock as should rank amongst the best that the present state of science could produce. The negotiations entered into at this time terminated in the employment of Mr. Dent as the maker of the clock. Of his production we have so far been unable to obtain any accurate particulars; but, in order to present some practical information on the subject of large clocks, we here give a condensed statement of the mode of construction proposed in the specification of Mr. Vulliamy, well known for his high standing as a maker of turret clocks.

The document states that it refers to an eight-day clock, proposed to be erected at the New Palace, Westminster, to show time upon four faces, about 25 feet in diameter, and to strike the hours upon a bell of 14 tons, and the quarters upon eight bells, with calculations of the size, weight, strength, &c., of the different parts necessary for accomplishing the said intention; with a description of what is considered to be the best mode of fixing the same.

The clock is divided into three distinct parts; and, with the exception of the communication by which the quarters are discharged by the going part, there does not exist any connection between the going part and either of the other parts of the clock. The hours are discharged by the quarter part. The going part is in itself extremely simple, and consists of only three wheels and two pinions: these give motion to nine other wheels, of which seven are the bevel-wheels, employed to effect a communication from the clock to the four pairs of hands. The clock is kept going while being wound. The diameter of the great wheel is 24 inches; it is cut into 180 teeth, and makes one revolution in five hours. The centre wheel is 21 inches in diameter, and has 300 teeth. The centre wheel-pinion has 36 teeth, and the scape-wheel pinion 20 teeth. The barrel round which the rope which carries the weight is coiled, is 14 inches in diameter, and makes 36 revolutions or turns, in 8 days and 7 nights. The work for communicating the motion from the body of the clock to the four pairs of hands is entirely carried by the frame of the going part, and is in no way connected with the building. The external hands may be set to time, when necessary, with the greatest facility, by means of the perfect accordance between these hands and those which indicate the time upon an internal dial, the seconds being shown by a hand which advances one division upon a graduated circle every two seconds of time.

The striking parts are calculated to meet Mr. Barry's instructions, viz., to strike the hours upon a bell of from 8 to 10 tons (which was afterwards increased to 14 tons), and the quarters upon eight bells: the requisite strength of this portion of the work has, in consequence, been carefully provided for.

The hour train consists of three wheels and three pinions. The hammer is raised by the second wheel. The great wheel is 3 feet in diameter, and is cut into 150 teeth; the second wheel is 2 feet 10 inches in diameter, and has 256 teeth; and the third wheel has 96 teeth. The second wheel-pinion has 50 teeth, and makes three revolutions to one of the great wheel; the third wheel-pinion has 30 teeth, and the fly-pinion 24. Independently of the above wheels and pinions, which constitute the train, there is the locking-wheel and pinion: this wheel is 28 inches in diameter, and has 234 teeth, and the pinion 24. The barrel is 2 feet 6 inches in diameter, 3 feet 8 inches long, and is intended to make nearly 49 revolutions, so as to enable the clock to strike during 8 days and 7 nights with once winding.

The quarter train consists of the same number of wheels and pinions. The great wheel is larger than that in the hour train, being 3 feet 7½ inches in diameter, and is cut into 180 teeth; the second wheel makes one revolution in one hour, is 2 feet 10¾ inches in diameter, and has 260 teeth; the third wheel has 144 teeth. The second wheel-pinion has 60 teeth, and makes three revolutions to one of the great wheel. The locking wheel is a blank wheel, which carries five pins, four to lock the quarters, and one to discharge the hours. To the second wheel is attached the barrel carrying the pins that raise the quarter hammers, which, consequently, makes one revolution in an hour. It is arranged to strike four quarters previously to the hour, and the other quarters at the proper times, each upon eight bells. The barrel carrying the line is 2 feet 3 inches in diameter, and 4 feet 2 inches long; it will make 60 revolutions, and enable the clock to strike 8 days and 7 nights with once winding.

It is proposed to make the wheels and large pinions of gun-metal; but the smaller pinions are to be of steel. The pivots are to work in gun-metal holes, the larger in that description of hole called a plummer block. All the arbours are to be made of steel, with the exception of the striking-barrel ardours, the ends only of which it is proposed should be steel: all the smaller pivots to be furnished with cocks, to carry screws to regulate the end-shake. The barrels, or drums, to be made of well-rolled copper.

The beds or bases which carry the wheels and different parts of the work are to be of cast-iron, and all the screws and fastenings of gun-metal, in order to avoid the effects of rust.

This mode of arranging the work in large clocks possesses many advantages over the ordinary construction, some of which will be noticed. In the latter, the whole of the work is contained in one frame, which being of necessity composed of several pieces, bolted and screwed together, it follows that, whenever it is necessary, for the purpose of cleaning or otherwise, to remove one of the bars of the frame, two or more of the wheels, or other pieces, pivoted into the same bar, become loose, and disengaged at the same time. This is always attended with much inconvenience and risk of damaging the work, particularly the teeth of the wheels. In the new construction, the going or striking part or parts are perfectly detached from each other: each part is supported upon a separate bed of cast-iron, and the arrangement is such that any of the wheels, or principal pieces, can be removed without disturbing any of the others. The pendulum bob is much heavier than those which are applied to turret clocks of the common construction, and, consequently, will be less affected by external causes. A 2″ pendulum, accompanied by a seconds-hand, affords great facility for regulating, and keeping a register of, the going of the clock. The suspension of the pendulum is perfectly independent of the clock, and the clock can be cleaned without disturbing the pendulum. There are a variety of adjustments connected with the pendulum and escapement for which this construction offers considerable facilities. The escapement is that which is commonly known as Le

Pante's dead escapement, and it is, in many respects, preferable for a large clock to that of Graham. All clocks showing the time externally are liable to be stopped by snow-storms impeding the hands; and whenever they are brought to rest in this manner, the point of the pallet is liable to come in contact with the point of the tooth of the wheel, or to catch, as it is termed. This is an accident of frequent occurrence; and when it happens to Graham's escapement, in which, the wheel being made of softer metal than the pallet, which is of steel, the former is very liable to be damaged from the pressure caused by the weight of the bob, and, in that case, the only remedy is a new wheel; whereas, in Le Pante's escapement, the damaged pin can be taken out and replaced by a new one, and the wheel will be restored to as perfect a state as before the accident. The mode of communicating the motion from the clock to the hands is extremely simple, and perfectly independent of the building: it is entirely supported by, and attached to, the base of the going part. Lastly, this construction offers very great facilities for cleaning, applying oil to the works, and keeping them in general good order.

REVIEWS OF NEW BOOKS.

Report on the Advantageous Use made of the Gaseous Escape from the Blast Furnaces at the Ystalyfera Iron Works. By James Palmer Budd. London: R. and J. E. Taylor, 1849. Pp. 16.

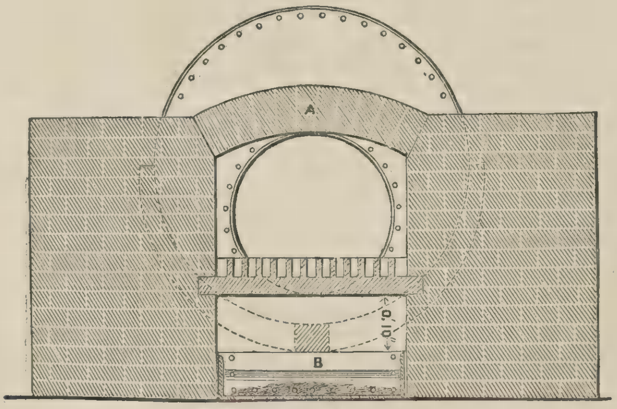
This is a reprint from the Report of the British Association for 1848. As its title shows, it is devoted to the consideration of the results obtained by the author, an eminent practical iron-master, in applying the vast heat of the gaseous matters arising from the combustion of the materials in the furnace, as a cheap means of producing the hot-blast for the twyeres. The value of Mr. Budd's improvements has before been fully elucidated by us at page 12, and the particulars of the process given at that time, render it unnecessary for us to remark upon them further now, except for the purpose of pointing out to our readers that they may now obtain the inventor's own statement in a detached form. We may strongly recommend a perusal of it to iron-masters and others connected with the working of blast furnaces as the plans laid down in it offer to economise the process of smelting to an extent not easy to be conceived.

CORRESPONDENCE.

FURNACE FOR ANTHRACITE COAL.

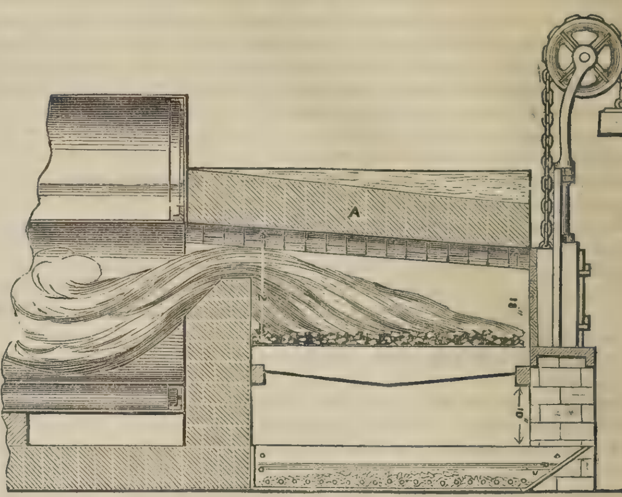
The sketches I have forwarded to you represent a furnace for burning anthracite, or any other coal, effecting a practical economy of 25 per cent. beneath a steam-boiler. Fig. 1 is a transverse section of the furnace, with its arched top, grate, bars, and ash-pit. Fig. 2 is a longitudinal section to correspond. In altering an existing furnace to suit this plan, it is not necessary to meddle with the setting of the boiler in any way, but only to bring the fire-bars outside the front of the boiler, and to build a fire-brick arch, A, over the furnace. The door-way is also of fire-brick; and a cistern, B, containing 8 or 10 inches of water, is set in the ash-pit, about 10 inches below the bearers. The fire-brick door has an outer door of thin sheet-iron set 5 inches in front of it. The use of this door is to prevent the access of cold air to the furnace. Several of these furnaces are in operation in this neighbourhood. At Clonmel distillery, where one of them is in use, Scotch coal has been used in it; but Irish anthracite is about to be tried in it, as a comparison with ordinary coal. According to the present system of working, the steam is well kept up with coal of a very bad quality, which could not otherwise have been used at all.

Fig. 1.



1 in. = 3 feet.

Fig. 2.



1 in. = 3 feet.

In another case, at Tralee, the engine grinds eight tons of Indian corn every 12 hours, with a consumption of $\frac{3}{4}$ of a ton of Welsh coal. When using anthracite, it must be spread very thinly on the bars; and my own opinion is, that the furnace must be larger than when ordinary coal is used, probably in the proportion of 15 inches square to a horse-power of the boiler.

Vulcan Foundry, Cork, April 28, 1849. John Steele.

RESISTANCE TO RAILWAY TRAINS.

It was not my intention to have again troubled you on the above subject; but your Penton Street correspondent has thrown down the gauntlet in such a manner, that I feel compelled to make a reply.

Even if I had the slightest personal knowledge of your correspondent, I would hesitate to make a journal, devoted to abstract science, the medium either of a personal dispute, or of forcing myself into public notice. It was the principles I attacked, and not the man; and, for my part, I can see nothing whatever unfair in writing on a scientific subject, and using initials. My name and address are in the editor's hands, who, no doubt, knows his profession too well to admit anything bordering on personality. There is no responsibility to shroud myself from; whether or not my initials are meaner or more inarticulate than his own, I leave to your readers. I might ask, why did he not raise the objection before? and why did he attack and reply to H. R.'s letters, if he had such a holy horror of initial correspondence? Why, the best communications which have appeared in the periodical literature of this country have been signed with initials; for every one is not surcharged with egotistical conceit to the extent of your correspondent. Therefore I shall continue to use initials; for printing my name in large capitals every month would no more enlighten the subject, than the statement of the colour of my skin, or my exact height to 16 places of decimals.

To analyse your correspondent's letter in full, would occupy far more space and time than it is worth. I deny having misplaced facts. Mr. C. is no authority on the subject; and I expect the book referred to has long since been worked up in covering band-boxes. He has no right to talk of "ponderous computations;" for, heaven knows, he has inflicted quite enough for half a dozen correspondents, on the readers of this journal; and, speaking of indicator diagrams, he says in paragraph seven, which I extract—"These last-named indispensable fashionable things represent only the nominal power of the engine, or that of the steam. How much thereof is expended in friction, and a strange variety of other insensible things which could be particularized—and, amongst the rest, how much of it, in certain cases, is wasted by the slurring of the driving-wheels on the rails—is what I ask for; but it will be a secret not to be told until a dynamometer is placed between the engine and train, after which, I repeat that shareholders will have an account by 'double entry,' and therein see how much fuel is unwarrantably consumed—a proof which will not be very flattering to the engineering talent of H. W., or his several practical friends."

Now, this is the crowning absurdity. After shuffling first from the pressure on the piston, and then, on being told of the difficulty of taking diagrams, he said that the temperature was all that was necessary. On the ridiculous nature of that being pointed out, and being actually told of the difficulty of getting correct results, owing to our being obliged to put the dynamometer behind the engine, he actually says that he can ascertain how much power is expended in friction, and slurring of the driving-wheels, by putting the dynamometer between the engine and train. Mr. Editor, I do feel myself utterly incapable of combating with such obstinacy. How can any human being ascertain the power lost by an engine from slipping, or its own draft and atmospheric resistance, by putting a registering instrument in a place where only the power exerted on the carriages can be taken off? This has always been the difficulty, and always will be; for you must calculate the resistance and friction of the engine from the best formula you have. This, I believe, is Mr. Hardings', which only errs in excess, and this is on the right side. Whose engineering talent is this most flattering to, most sapient Penton Street correspondent? I pass over the paragraph in which he holds some fancied neglect to be a slur on the government, as, perhaps, when it meets the eye of that body they may resign, to escape the terrific consequences of the slur. I therefore come to the next. If any one will be at the trouble of turning to the last paragraph of his letter, at p. 282, vol. i., it will be at once seen what he really did say, and who really misplaces facts.

On temperature and pressure I will give a problem presently. The charge of unfairness I dispose of first. I wish, therefore, only to extract the last sentence of that paragraph, which shows Mr. C.'s wonderful acuteness, and is, at the same time, exactly apropos to every subject he has touched. He says, "In taking leave of my disguised antagonist, I assume his best friend will say he has improvidently pounced on a matter which, for their interests, he had much better have let alone, and that his side-attempts to upset matters of fact constitute a miserable failure." Pretty well this after the absurdity in paragraph seven!

If Mr. Curr can show, that putting a dynamometer between an engine and train will show how much power is expended by that engine in friction, and by the slipping of the driving-wheels, I will withdraw my assertions, and acknowledge myself to be wrong; and I hope, that if he cannot prove his assertions, he will at once have the honesty to state that he is entirely ignorant of the subject he has been writing about.

Paddington, May 10, 1849. H. W.

P.S.—I see nearly four columns of temperature and pressure of steam, which is very profound indeed. I am sorry that my saying that I knew the relation between temperature and pressure, should have so troubled him; however, I will give him a problem—the well-known American one:—Assuming that there is a certain amount of heat in every substance, even in snow, and that absolute cold is unknown: required—the exact number of snow-balls, 3 in. diam., to boil 2 gallons of water in 1 hour, in a tubular boiler. Mr. C. can clear off the cobwebs, and, by intense reasoning—difficult to communicate, and two variations, one infinitely small, and the other of vast magnitude—can give us this within a million of millions, which will be as exact as most of his calculations.

THERMOMETRIC OBSERVATIONS.

In a frisk of genius befitting men of uncontrollable mind, H. R. in his last essay must have overlooked the staring fact, that it is not I, but himself, who is suffering under the indictment of having written a parcel of nonsense, under pretence of making up a question in a case of experimental physics.

In the lorn hope of escaping conviction, which might damn his mathematical repute, he has made a side effort to tarnish my papers on his "Thermometric Observations," with a stick out of his own tar bucket, as if besmearing his accuser would free him from disgrace, or disfiguring a word to rhyme with my name, might not be mistaken for vulgar wit.

Instead of having raised an objection to the demonstration in my last, in explanation of a sentence that "the contents of the bulb of a thermometer must be in a definite proportion to the section of its stem," he renews his charge afresh in other words, that of my having attempted to establish "proportionality of heterogeneous quantities." Of the nature of these quantities, we have been pedagoguically instructed in a former essay, to wit, "that the contents of a bulb, being a solid or figure of three dimensions, and the section of a stem being a surface or figure of two dimensions, there cannot exist in the nature of things any proportion between them, the fundamental idea of proportion involving a common unit, which can have no place in heterogeneous quantities."

From such sophistic logic of the schools, thanks to the heavens I am free; for if such trash were true, neither could the surface of a circle, which is a figure of two dimensions, be compared with the solid content of a sphere, because, forsooth, the latter is a figure of three dimensions; nor, by the logic of our scholastic philosopher, could the diameter of a steam-cylinder be made in any definite proportion to the surface or solid content of the boiler in which the steam receives its elastic pressure, because a diameter is but of one dimension, a surface of two, and a solid of three!!!

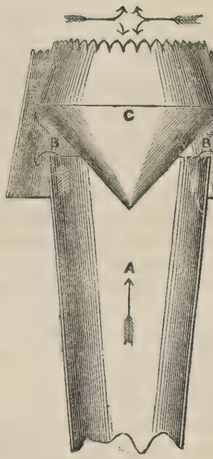
I will add, that I had no design to charge H. R. with culpable concealment of the circular multiplier, but I distinctly avow that, according to my logic, its suppression would be followed by an error. Mercury and glass dilate in different proportions: the surface of a spherical bulb to its contents, is in the same proportion as the surface of a cube to its contents; so also are the differences, but alack they are not equal. H. R. has so whined about my decimal places, that he shall have the difference in fractions, which would have been exactly as $\frac{1309}{2500}$ to 1, and which, on his own authority, he may take as "a melancholy proof of my inability to deal with anything mathematical."

Now let him learn that scraps of Euclid are dangerous things to meddle with, and that he is convicted, as have been many before him, of trying to settle a complex question as if it were a simple one. To conclude, in language intelligible to all, instead of bettering his position, he has reduced his tone of mathematics to the level of "tom-foolery;" and should he be a youth in his teens, or under tutelage, he may have received from my hand a lesson for which, in riper years, he may be grateful. In saying farewell, I congratulate him on having scrupulously retained his incog.

7, *Upper Penton Street, May* 3, 1849. John Curr.

WHITE'S CHIMNEY-POT OR VENTILATOR.

The annexed sketch exhibits a vertical section of my registered chimney-pot, or ventilator, which I have found very effective in practice. A, Is the pot, or finish of the flue, expanding from the bottom, the upper portion of which is surrounded by a hood, B, open at top and bottom, containing also a species of double cone, C, suspended so as to leave an annular vent direct from the flue, A, to the top.



When the atmosphere is stationary, there is nothing to prevent the escape of the smoke or air by the annular space at the top; and the same thing occurs if there is a horizontal wind, the course being identical with that of the upward arrows. But, supposing this wind to strike a wall, deflection will ensue—two winds will blow in opposite directions, and the stronger will overcome the weaker, forcing it back, and this contact will cause the air to radiate in a plane at right angles to the line of direction of the currents, resulting in a perpendicular movement. This is marked in the sketch by the double-headed arrows. The air will now pass down the annular space at the top, and deflect the upward current of the smoke, as represented at B B, carrying it out by the open bottom of the hood. In this way the smoke surrounds the pot like a jacket; and, as the pot diminishes in diameter downwards, the vapour gets mixed with air, and partially condensed, and this condensation is found advantageous in assisting the draft of the chimney. Compared with other schemes for the same purposes, the peculiarity of this chimney-pot consists chiefly in the shape of the internal cone. Pots with rounded or pointed tops must cause considerable resistance to the ascent of the smoke, as all the particles combat each other to get out; but in my arrangement, they are kept apart from each other.

St. Mark's Schools, Jersey, April, 1849. George White.

YATES' DEAD-BEAT, HALF-SECONDS' WATCH ESCAPEMENT.

With the interest and pleasure of five years' subscribing to and reading your Journal, I trust you will not think that I am taking a liberty in attempting to correct what appears to me to be an error at page 9, of your April Number. It relates to Mr. Yates' half-seconds' watch escapement, wherein the error seems to be in the form the inventor suggests for one pallet—namely, that it should be concentric, like that of Graham's dead-beat escapement, used in clock movements.

The object at which, I conceive, the inventor aims, is doubtless that of obtaining the impulse of the power without the evil of *recoil.* To compass this, would certainly be a very valuable improvement in the lever escapement; but I do not see that he has effected that requirement. If it is correct for one pallet to be circular, why not for the other? The reason of the angle of the pallets, is to prevent the possibility of the lever pin coming in contact with the roller, thus causing the vibration of the balance to diminish, to the great detriment of the uniform performance of the movement.

If in your power to induce Mr. Yates to give a satisfactory explanation of the discrepancy I have pointed out, I shall feel obliged.

Thomas Leonard, Clock Manufacturer.

50 *Tabernacle Walk, Finsbury Square,*
London, April 23, 1849.

THE TEMPERATURE AND PRESSURE OF STEAM.

(Continued from page 40.)

To whatever law the pressure of steam be subject at and above the boiling point of water, the same law is available at lower temperatures, for in both cases the pressure is consequent on the same cause, viz., increased temperature. Therefore, to find the pressure due to any given temperature, taking as data that a column of 30 inches of mercury is in equilibrio with the pressure of steam at the temperatures of 100 and 212 degrees respectively, by the scales of Celsius and Fahrenheit, let t equal the numerical degree of temperature by the centigrade, and T the same by Faht. when F is the pressure in inches of mercury; and by

Formula 3. $F = \left(\frac{t}{100}\right)^4 \times 30$,—the pressure in inches of mercury, when the temperature is given by the centigrade.

Formula 4. $F = \left(\frac{T - 32}{180}\right)^4 \times 30$,—the same by Fahrenheit.

In the above formulæ, both scales have been supposed to represent true temperature, and which is now to be examined. It was formerly supposed that water at the freezing point does not emit vapour (see Mr. Russell's Treatise, p. 58), and Mr. Dalton has the merit of having been the first to escape from the natural enough error of assuming the vapour of water at $32° = 0$. It is also said that his apparatus is the most simple and refined of any that have been employed for temperatures below 212°, and that his experiments are those which, to the present day, have the greatest authority.

Later experiments have been made by Dr. Ure, and published in the *Philosophical Transactions* of 1818, who says that *his* apparatus has the peculiar advantage over *all others*, that the mercurial column is never heated; which plainly signifies that Mr. Dalton having heated both the water to be vaporized, and the mercury in the syphon of his apparatus, whereby its density was reduced, and the length of the column thereby increased, the result produced was deceptive, as the column of mercury in the syphon was the indicator of the increase of pressure.

Ure, in describing his apparatus, says, the mercurial tube was provided with a shoulder near the top, to which heat was communicated by two argand flames; and adds, that it is the concurrent opinion of all chemical philosophers, that heat travels downwards in liquids with extreme slowness and difficulty, and that Count Rumford's experiments led him to infer, that heat will not descend in fluids at all.

Taking such as fact, it may be assumed that Ure's experiments would give lesser pressures than Dalton's; but the results are the reverse, and the cause is now to be shown. Although fluids cannot be heated directly downwards, it is otherwise as to the vessel containing them, as noticed by Count Rumford, by which the fluid within is heated indirectly.

Then, as one repetition of the doctor's experiment occupied on the average seven hours, the time was ample for two argand flames to communicate heat from the shoulders to the glass tube, and thence to the mercury within, whereby a still greater error was produced than by the faulty apparatus of Mr. Dalton.

Both philosophers carried their experiments to three decimal places, or to the thousandth part of an inch, and Dr. Ure declares that his pressures are *untrimmed*, and presented to the public as they were recorded on the instant of their being made. The pressure at 32° is set down at 0·2 inch, and at 40° at 0·25, the difference being exactly the 20th part of an inch, a space which must be distinctly visible on any scale by which the thousandth part of an inch is discernible. Nevertheless, he says, that from 32° to 40° the pressures could not be taken with suitable precision!! This acknowledgment, taken in conjunction with what has been said as to his apparatus, amounts to a proof that water does not give out vapour within the limits specified; and if further reasoning be requisite to establish the fact, I submit, that no mental faculty of man can encompass the idea, that water being enclosed in a vessel, and out of contact with the atmosphere, shall give out vapour at the same time that its density is being increased, and its volume proportionally diminished.

If this be admitted, it follows that the place of zero, or any *scale of the temperature of water and its vapour*, the numerals of which represent true and relative temperature, must be at the point at which water is at its maximum density, as from that point only its dilatation is equable and proportional to its increased temperature; for by the scales in use, as the mercury in the thermometer expands, the volume of water within corresponding temperatures becomes less, therefore 4 degrees must be cut off Celsius, and 40 from Fahrenheit: for example, the temperatures on the centigrade being taken at 6 and 12 degrees, are in the proportion of 1 to 2, but the corresponding true temperature would be 6 — 4, and 12 — 4, which is as 1 to 4.

The true place of zero being as I think fixed, enables me to explain why the experiments of the French Academy, which were made on an ascending temperature, gave lower results than the formula, when, from the chief cause assigned in the former paper, the results of the formula should have exceeded those of the experiments. The explanation is, that the point of zero being misplaced 4 degrees on the centigrade, and although the division of the scale in formula 1 is 100, the extreme differences by a true scale would be changed from — 2·07, and — 3·52, to + 1·93° and + 0·48°. Whence the actual greatest difference of formula 1, and the experiments up to 20 atmospheres, is only + 1·93°, being 0·07 atmospheres; whilst at 20 atmospheres, the difference of the experiments of the French Academy and Franklin Institution is 7·52 degrees or 2·82 atmospheres.

In the following table, column 1 is the temperature by Faht.; col. 2, the pressure by Ure; col. 3, the same by Dalton; col. 4 is the pressure by formula 4; col. 5 is the difference between col. 4 and 2; and col. 7 is the result by a true scale of temperature as described above, when the temperature is that in col. 6:—

1 Faht.	2 Ure.	3 Dalton.	4 Form. 4.	5 Difference.	6 True Scale.	7 In. of Mer.
40°	0·250	0·263	0·000	0·250	10°	0·003
50	0·360	0·375	0.003	0·357	20	0·048
60	0·516	0·524	0·017	0·499	30	0·243
70	0·726	0·721	0·059	0·667	40	0·768
80	1·010	1·000	0·150	0·860	50	1·875
90	1·360	1·360	0·322	1·038	60	3·888
100	1·860	1·860	0·603	1·257	70	7·203
110	2·456	2·530	1·054	1·402	80	12·288
120	3·300	3·330	1·700	1·600	90	19·683
130	4·366	4·340	2·626	1·740	100	30·000
140	5·770	5·740	3·888	1·882	110	43·929
150	7·530	7·420	5·521	2·009	120	62·208
160	9·600	9·460	7·665	1·935	130	85·683
170	12·050	12·130	10·319	1·731	140	115·248
180	15·160	15·150	13·689	1·471	150	151·875
190	19·000	19·000	17·740	1·260	160	196·608
200	23·600	23·640	22·733	0·867	170	250·563
210	28·880	28·840	28·577	0·303	180	314·928
212	30·000	30·000	30·000	0·000	190	390·963
					200	480.000

It may be noticed that col. 7 is the *exact* pressure throughout, corresponding to the degrees in col. 6; thus, $\left(\frac{200°}{10°}\right)^4 \times \cdot003 = 480$, the pressure at 200°. Also, that the greatest difference between Ure's experiments and column 4 is 2·009 inches of mercury, being the 15th part of one atmosphere.

John Curr.

7 *Upper Penton Street, London, May* 1, 1849.

Postscript.—Since the completion of the former paper, I have examined the original report of the French Academy, and perceive that Mr. Russell has failed to notice that 100° of the centigrade is to be taken as unity, which will *reduce* the error mentioned by millions of millions, but I still acknowledge my incapacity to make their formula and table agree. He has also misentitled the column "elastic forcemeters in *feet* of mercury," which in the original is "elastic force in *metres* of mercury," the difference being about 2·5 to 1. Lastly, in converting the degrees of Celsius into Faht. at 40 atmospheres, he has committed an error of 20°, the temperature being stated 466·6° instead of 486·6°.

This error being corrected, table 2 in the former paper may be continued as follows:—

Atmos.	French Acad.	Franklin Inst.	C.	R.	CR.	RL.
30	457·2° F.	—	453·27°	444·6°	3·93°	12·6°
40	486·6	—	484·53	470·5	2·07	16·1
50	510·6	—	510·64	491·4	0·04	19·2

The commissioners of the Academy observe, that at 50 atmospheres their error cannot be 1°, but at lower temperatures they admit their formula incorrect. It is $t = \frac{\sqrt[5]{f} - 1}{0{\cdot}7153}$; t being the temperature in degrees of the centigrade, taking 100° as unity, and f the elasticity in atmospheres of $0^{m}{\cdot}76$.

In the notation of the formula throughout the last paper on this subject, as, for example, in the last line but one of the first column, page 39, for $(a)\ \frac{1}{4} \times 100$, &c., read $(a)^{\frac{1}{4}} \times 100$. In second column, page 40, second line, however, $t = \frac{F^{\frac{1}{5}} - 1}{0{\cdot}7153}$ stands quite correct. Also, in same column, line 13, for *inserted*, read *inverted;* and in second column, page 39, first line, for $\times$ 32, read $+$ 32.

RAILWAY SIGNALLING.

Whilst so much is being said on the subject of railway signalling, you will perhaps permit me to throw in a few remarks, with the intention of affording a hint for a better means of communication between the passengers and guard than at present exists. On one of the axles of each carriage, I propose to fix a hammer, or clapper, so as to revolve with it; and immediately over the plane of motion of this hammer, I would hang a plate, or disc, of some sounding metal, hinged to the bottom of the carriage. Along the top of each carriage, in the inside, is run a light rod, passing from end to end of the line of compartments; and in each is a short handle, available for the use of the passengers in case of accident. On drawing forward any of the handles, the rod upon which they are placed, acts upon the upper part of a long vertical lever, working on a fulcrum fixed on the outside of one end of the carriage. The lower end of this lever is continued by a jointed link passing beneath the bottom of the carriage, to support the sounding plate, so as to clear the revolving hammer when not in action; but when moved as described, the plate is deprived of its support, and, falling down to a vertical position, it comes in contact with the hammer, which, at each revolution, strikes a sudden alarm blow. This attracts the attention of the guard, who is at once enabled to discover the carriage where his services are required, by the angular position of the lever at the outside.

After the plate has been dropped, it may be easily elevated by a wire, or string, attached to it.

To prevent the risk of needless alarms, a ratchet-catch might be fitted to the lever apparatus, so that, when it had once been moved, it could not be returned to its place by any one in the interior of the carriage; and detection of the cheat would be certain.

Glasgow, April 11, 1849. W. J. Warner.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

April 17, 1849.

Robert Stephenson, Esq., M.P., Vice-President, in the Chair.

"On an application of certain Liquid Hydrocarbons to Artificial Illumination," by Mr. C. B. Mansfield, B.A. The paper first noticed, that liquid hydrocarbons had been comparatively little used for the production of artificial light; and that, in the instances in which they had been applied, their liquidity, and not their evaporability, had been turned to account.

In the use of the common volatile oils, the excess of carbon in their composition was the great difficulty; but when that was surmounted, that excess became an actual benefit.

There were two methods of rendering this carbon efficient as "light fuel," when advantage was taken of the volatility of the substances: one was, to cause the vapour, as it escaped from a jet, to mix rapidly with the air. The other, to mix the vapour, before combustion, with other gaseous matters containing less carbon. The adoption of the first of these was instanced in Holliday's recently patented Naphtha Lamp. The second consisted of the new arrangements described in the paper.

This principle was carried into practice in two ways. The first (which was illustrated by a lamp that was burning on the table) was effected by mixing the hydrocarbons with some other inflammable spirit containing very little carbon. The mixture was described as being made in certain definite proportions, which insured a perfectly white light, and from which any deviation would result in a flame of inferior quality,—pale, if the hydrocarbon were deficient; smoky, if the mixture were poor in spirit. The ingredients most accessible in this country were stated to be, wood, spirit, and a volatile oil from coal naphtha, in the proportions of two-thirds of the former to one-third of the latter. Alcohol and oil of turpentine had been similarly used on the continent, though the former was too dear for use in England.

The other adaptation of the same principle, and that which it was the chief object of the paper to describe, was the dilution of the hydrocarbon vapours with permanent gases of inferior, or even of no illuminating powers.

That application might be called the naphthalization of gas, or the gasization of naphtha, according as its main object was to enhance the services of the gas, or to utilize the liquid; the latter was the object of the new proposal described in the paper. The former had been already accomplished by preceding inventors.

The first invention was that of Mr. Donovan in 1830, who proposed to confer illuminating power on gases that were inflammable, but not luminiferous, by charging them with the vapour of hydrocarbons; but from the want of a sufficiently volatile fluid, he was compelled to have a reservoir close to every burner. The next application was that of Mr. Lowe, who increased the light obtained from coal gas by passing it over surfaces of naphtha. Mr. Beale's air light was then noticed; its object was to use hydrocarbons for illumination, by passing a current of air through vessels containing those liquids. There existed, however, the same obstacles to this plan as to that of Mr. Donovan, viz., the heat required to evaporate the only liquid hydrocarbons then accessible.

The paper represented that at length the difficulty had been solved, by the discovery of a liquid hydrocarbon, as volatile as spirits of wine, but containing sufficient carbon for the most perfect light, and obtainable in any quantity. This hydrocarbon was procured from coal tar, and was called "benzole." Its volatility was such as to enable it to naphthalize atmospheric air as effectually as ordinary naphtha did coal gas.

The system proposed by the author (which was illustrated in the room by a working apparatus) consisted in conducting a stream of almost any gas, or even of atmospheric air, through a reservoir charged with benzole, or some other equally volatile hydrocarbon; the gas or air so naphthalized being then conducted like common coal gas through pipes to the burners. It was stated, that the system was applicable on any scale, from the dimensions of town gas-works to the compass of a table lamp. In the apparatus exhibited, a small gas-holder, filled by a pair of bellows, supplied common air through pipes. The gases formed by passing steam over red-hot coke would answer well for this purpose, and it would depend on local circumstances whether this mode of generating current air would be preferable to the expenditure of the mechanical force necessary for driving atmospheric air through the pipes. Pure oxygen charged with the vapour would explode on ignition; it was therefore suggested that this might prove a useful source of motive force. It was, however, stated to be difficult to form an explosive mixture of the vapour with common air. By decomposing water with the voltaic battery, naphthalizing the hydrogen with benzole, and burning it with the aid of the equivalently liberated oxygen, a simple light of intense power might be obtained. The system was shown to be a great simplification of the ordinary system of gas-lighting, as no retorts, refrigerators, purifiers, or meters were required, and the products of combustion were as pure as those from the finest wax. It was expected that the elegance of the material, and the simplicity of the apparatus, would induce its introduction into buildings and apartments where coal gas was not now considered admissible.

The apparatus and conditions necessary for the success of the method were, a flow of cheap gas, or of air, driven through pipes by any known motive power, and a reservoir of the volatile spirit, through which the main pipe must pass in some convenient part of its course; these pipes and reservoirs being protected from the cold. It was stated, that though the liquid did not require to be heated above the average temperature of the air, it was liable to become cooled by its own evaporation, so as to require an artificial supply of warmth. This was readily effected by causing a small jet of flame of the gas itself to play upon the reservoir, and by a simple contrivance, called a "thermostat," by which the flame was shut off when necessary, the temperature could be made self-regulating, so as never to rise above or fall below a proper degree. The cooling due to the evaporation, would, of course, be inversely proportionate to the quantity of liquid in the reservoir. If atmospheric air was used as the vehicle for the vapour, the jet-holes in the burner, from which it escaped for combustion, must be slightly larger than those for coal gas. Some burners, contrived for the purpose of accurately adjusting the size of the orifice to the quantity of luminiferous matter escaping, were exhibited and described; they were made so, that by moving a part of the burner, any required quality of flame, from lightless blue to smoky, could be obtained, there being a medium point at which the most perfect brilliancy was arrived at. The burners would answer equally well for coal gas, though that material could not, even by them, be made to evolve so white and pure a light as that from benzole vapour.

In conclusion, some data were given on which a calculation of price was founded. It was stated, that a gallon of benzole, of the degree of purity requisite for the purpose, would cost about two shillings and sixpence; to this, the expense of the air current and the interest of the original outlay on apparatus was to be added. This the author presumed would not raise the cost to more than four shillings for the consumption of a gallon of benzole. It was stated, that one ounce of that liquid would give a light equal to four wax candles, of four to the pound, for one hour; or one gallon for about one hundred and twenty hours. It was inferred, that a gallon of this material was equivalent to about one thousand cubic feet of coal gas.

Finally, for comparison with coal gas at a distance from the mines, it was stated, that while to produce one thousand cubic feet of gas, at least two hundred pounds of coal must be transported, one gallon of benzole did not weigh more than seven pounds; this, in carriage, would give benzole an advantage of twenty-eight to one over coal as a source of light.

In the discussion which ensued, high encomiums were passed upon the talent and patient labour exhibited by Mr. Mansfield in the investigation of this important subject, which promised to lead to most remarkable results, as an extension of gas lighting to positions where it had not before been considered applicable.

April 24.

William Cubitt, Esq., Vice-President, in the Chair.

The paper read was "On the Construction of Locomotive Engines, especially those modifications which enable additional power to be gained without materially increasing the weight, or unduly elevating the centre of gravity," by Mr. T. R. Crampton, Assoc. Inst. C.E. It was contended, that the durability of the working parts of the engine, the stability of the permanent way, and the freedom from oscillation, so essential for the comfort of travelling, all depended upon the steadiness of the engines when at high speeds. This consideration led the author to introduce several modifications of the ordinary construction of locomotives; the driving wheels were removed from the centre of the engine to behind the fire-box, placing all the weight on and between the extreme points of support. The centre of gravity was so reduced, that, on the narrow guage railways, the angle of stability equalled that of the broad guage engines. All the moving parts of the machinery were removed from beneath the boiler and placed on the two sides, within the easy inspection of the workmen, and enabling the repairs to be effected with ease and despatch. These dispositions had the effect of enabling a larger amount of heating surface to be given in the boiler, within a certain length of engine, than even in the larger class of engines of much heavier weight; thus, in fact, simultaneously concentrating the power and reducing the weight.

Upon this principle, some engines of a smaller class had been constructed, containing the water and coke tank within the same frame and on the same wheels as the boiler; this arrangement became practicable in consequence of the removal of the machinery from beneath to the two sides, leaving a convenient space for the tank, and the whole weight was placed within the extreme wheels, reducing, at the same time, the centre of gravity of the mass; for it was argued, that the two points of importance were to place the weight on and between the extreme wheels, and to bring the line of traction identical with the centre of gravity of the moving mass.

These positions were illustrated by a set of diagrams, showing the various constructions of engines that had been induced by the requirements of railways, and the demands, whether for economy of fuel or increase of speed, and demonstrating that the class of engines having the driving wheels under the centre of gravity of the boiler, was that which oscillated most at high speed; but that the class possessing the greatest amount of steadiness, was that in which the driving wheels, and the weight which must accompany them, were removed to the hinder extremity of the engine.

The paper gave the details of the various changes, and the arguments for and against each class of construction, and the author requested, that if his reasonings were proved to be fallacious, some rules should be laid down for guiding the general practice of engineers in the construction of locomotives.

In the discussion which ensued, the arguments chiefly went to show, that it was the length of the base, or the area of the space covered by the wheels, rather than their position, and that of the weight upon them, that induced steadiness. On the other hand, it was contended, that although additional steadiness had been obtained in the old engines by thus extending the length of the base, yet that if, as had been shown to be practicable, a greater degree of steadiness could be obtained from an engine of less length between the extremities, when the driving-wheels were removed from the centre to the extremity, it was manifestly advantageous to adopt such a form of construction. This was practically instanced by a small engine, of less than nine feet between the centre of the wheels, running with perfect steadiness at high speed; whereas, with the old class of engines, it had always been considered necessary, for safety, to have at least eighteen feet between these centres.

May 1 and May 8.

Joshua Field, Esq., President, in the Chair.

The discussion on Mr. Crampton's paper, "On the Construction of Locomotive Engines," was continued through both these evenings. The same tone of argument was kept up, and numerous instances were adduced supporting the views of both sides; but without arriving at any definite result, other than that it was desirable in all engines to lower the centre of gravity, in order to establish a great angle of stability, and to arrive at a ratio between the circumference of the driving-wheel and the cubic content of the cylinders, such as, whilst the greatest speed might be maintained with an economical consumption of fuel, every facility should be afforded for starting rapidly, which was a point of importance on lines running frequent trains. On the one hand it was argued, that small driving-wheels were essential for quick starting; and on the other hand it was contended, that with a given amount of evaporating surface in the boiler, the tractive power would be the same under all circumstances at the periphery of the driving-wheel, provided a given relative proportion existed between the cubic content of the cylinder and the circumference of the driving-wheel, and that large wheels reduced the wear and tear.

The long disposed of question of the stability of the long-boiler engines was again cursorily touched on and disposed of.

The diminution of the wear and tear of the sides of the brasses of the engines, having the driving-wheels behind, and the greatest weight upon the extremities, leaving a comparatively light load on the centre-wheels, was adduced as a proof of their stability, an engine of that kind having run twenty-five thousand miles without any appreciable lateral wear; whereas an ordinary engine on the same railway, had worn away the thickness of a quarter of an inch whilst running the same distance.

A short paper was read, describing a kind of permanent way, which had been somewhat extensively laid down on the Lancashire and Yorkshire, and other railways, in the north of England, by Mr. Hawkshaw, M. Inst. C.E. The principle was that of a bridge-rail, weighing seventy-five pounds per yard, placed upon continuous longitudinal timber bearing; and the novelty consisted in having at each joint a malleable iron-plate chair, with a projection on the upper surface, fitting within the interior of the rail, and the flanches, which were fourteen inches long by eight inches wide, and half an inch in thickness, attached to the rail by rivets in such a manner as to fix them firmly together, and yet to allow for the expansion and contraction caused by the variations of temperature. The details of the arrangement were very simple and complete, and it appeared to succeed perfectly, as in an extent of twenty miles of railway so laid, over which numerous heavy trains had ran daily, at considerable speed, for the last year, only three rivet-heads were found to have been knocked off when recently examined.

May 15.

The discussion on Mr. Hawkshaw's paper, "On a longitudinal continuous bearing Permanent Way," was continued throughout the evening, to the exclusion of every other subject. Some interesting observations were made on the actual destruction of the cast-iron chairs and double-headed rails, and the advantages that would result from the more general substitution of continuous longitudinal timber bearings for the present transverse sleepers and cast-iron chairs. The gradual ameliorations that had taken place in the forms and strengths of the bridge rails and their various fastenings were discussed; and it was contended that the hollow bridge rail was more durable than any other, that the upper surface was more compressed in rolling, and that the system of connecting the end, whether by riveting to a plate, or by bolts and nuts, made a better and more even joint, and therefore produced a more level surface for the engines and carriages to run upon. The duration of the timber was declared to be such, that a second set of bridge rails had been laid down on the longitudinal timbers, whereas the cross-sleepers had never been able to bear that. This, however, it was asserted, arose principally from common timber being used for the transverse sleepers, whilst the best kind, well creosoted, was used for the longitudinal bearers.

The system of inserting a piece of hard wood between the rail and the main timber, as on the Great Western Railway, was much approved, as was also the plan of side transoms halved into the main timbers, as it enabled a better system of drainage to be employed, than had been usual with that kind of permanent way.

The new systems tried by Mr. Samuels on the Eastern Counties Railway, and of which several models were exhibited and described, received much commendation, particularly the plan for dispensing with the joint chairs, and uniting the ends of the rails by two side-pieces, or fishes, of cast-iron, bolted through and to each other, so as to render that part quite equal in strength to the body of the rail. The question of the means of allowing for the contraction and expansion of a line of securely-fastened rails was discussed, as was the creeping or advancing motion of rails in the direction of the traffic.

The general opinion seemed to be decidedly in favour of the longitudinal bearing, although it was admitted that many of the transverse sleeper railways, for instance, such as had been laid on the plans of Cubitt and of Hawkshaw, were so good, that it was not to be presumed they would be removed to make way for the longitudinal system.

The President reiterated an invitation to his Conversazione, on Tuesday, May 22d—for which he requested good models and works of art; and the meeting adjourned until June 5th, when the monthly ballot for members will take place, and Mr. Howard's paper, "On the method of Rolling the Links of the Chains of Suspension Bridges," will be read.

INSTITUTION OF MECHANICAL ENGINEERS.

The ordinary general meeting of this society was held on the 25th of April last, Mr. R. Stephenson, President, in the chair. In opening the business of the meeting, the Chairman remarked, in a brief manner, upon a point which deserves the attention of the profession. He stated that it was necessary that he should express to them how apprehensive he was—at least, that he had apprehensions—of an institution of that kind failing for want of energy on the part of its members. What had hitherto been the character of almost every institution of this kind in this country? almost universal failure. It was a remarkable circumstance, that in a country like Great Britain, whose wealth and power are so closely connected with the development of the Mechanical Arts and Sciences—it appeared to him, in fact, a complete anomaly—that institutions of that kind should not appear to reach a higher standard than they now had. They saw Astronomers cultivate and maintain a society for extending their knowledge of the movements of the heavens. They saw Geologists maintaining and extending societies for investigating and developing the structure of the earth. They saw Physiologists and Botanists maintaining and extending their societies for investigating and developing the knowledge of the animal and vegetable productions of the earth; yet they had witnessed only languidness and inactivity in the pursuit of those arts and sciences on which the nation's wealth absolutely depended. That it should be the case was to him the more remarkable, because the nation stood pre-eminent for their mechanical abilities. It was not egotistical in him to say this in Britain, because all foreigners conceded to them an unmeasured pre-eminence in those particular arts. Without despairing, therefore, of the success of the institution, he felt that, in undertaking the task he was now doing, it was necessary that he should impress upon the members the absolute necessity of co-operating with him with energy in the further development of the Institution. With that strong conviction on his mind, he wished also strongly to impress it on them, for without energy and industry they must fail as heretofore. He would endeavour to do his part, and trusted and hoped most sincerely that the members would not fail in doing theirs, for without their assistance no efforts of his would sustain an Institution of that kind.

The attention of the members was then drawn to Mr. Baines' paper on his New Railway Chairs and Switches, reported by us last month. An estimate of cost was presented, showing that, for a mile of single way, with square taper spikes, the new system might be laid down for £340—against £348 for the same on the old plan—with screwed spikes, the cost would be increased to £363. The square taper spikes are considered to be the best, as they are equally efficient, and are more convenient for extraction in repairs. The plan is to be tried upon a portion of main line, with the view of testing it more fully than has yet been done. The remarks on this plan were followed by a paper on an "Express Engine," by Mr. Weallens of Newcastle. The engine was made by Messrs. Robert Stephenson & Co., in 1848, for the York, Newcastle, and Berwick line, and is intended to work the express trains between Newcastle and York—83 miles—when the line is relaid. It is at present running between York and Darlington.

This engine has inside cylinders with a crank axle; and six wheels, inside bearings for the crank axle, and outside bearings for the leading and trailing axles.

The cylinders are 16 inches diameter, and 20 inches stroke. The valves are vertical, and are placed on the outer side of each cylinder, instead of the inner side; the exhaust passages are carried under the cylinders, and unite at the blast pipe. The steam ports are $1\frac{1}{4}$ inches wide by 13 inches long, and the exhaust ports $2\frac{1}{2}$ inches by 13 inches; the traverse of the slide valves is $4\frac{1}{2}$ inches. The eccentrics are fixed on the ends of the crank axle outside of the wheels, and the valves are worked by the expansion link motion. The pumps are worked by the same eccentrics, and are fixed at the sides of the fire-box. The boiler is 3 feet 10 inches diameter, and 11 feet in length, containing 174 tubes of $1\frac{7}{8}$ inches outside diameter, and 11 feet 5 inches length. The inside fire-box is 3 feet 9 inches long, by 3 feet 8 inches wide, and 4 feet 9 inches high from the top of the fire-bars to the underside of the roof.

The heating surface in the fire-box is......................	82	square feet.
" " " tubes..........................	964	"
Total heating surface..........................	1046	"

The driving-wheels are 6 feet 6 inches diameter, and the leading and trailing-wheels are 3 feet 9 inches diameter.

The outside and inside framing consists each of a single flat wrought-iron plate, 1 inch thick and 8 inches deep; the inside frame is bolted to a flanch upon the cylinder, and to a bracket on the fire-box; the outside frame is bolted to a flanch upon the steam-chest, which is in one casting with the cylinder, and is attached to the boiler by three wrought-iron brackets on each side. The weight of the engine in working trim is about 22 tons.

The consumption of coke was stated by the Chairman to be 18 lbs. per mile with express trains of three or four carriages; this amount includes the fuel used in getting up the steam.

ROYAL SCOTTISH SOCIETY OF ARTS.

April 9, 1849.

George Lees, A.M., Vice-President, in the Chair.

"Account of a Binocular Camera, and of a method of obtaining drawings of full length or colossal statues, and of living bodies, which can be exhibited as solids by the stereoscope." By Sir David Brewster.

In this paper the author pointed out the changes which take place in the visual representation of bodies of three dimensions, such as statues, buildings, and living bodies, when they are viewed at different distances by one or both eyes, or when reduced copies of statues are viewed in a similar manner. He showed that full-length and colossal statues, as works of art, are not so perfectly seen as reduced copies of them, and that there is, *cœteris paribus*, a certain ratio between the distance of the eyes and the magnitude of a body of three dimensions, when its visual form is best developed. The author then described a Binocular Camera, and explained a method of obtaining, by its means, such dissimilar drawings, on a plane of full-length and colossal statues and living bodies, as will give the best representations of them in relief when united by the stereoscope.

The Binocular Camera, described by the author, is composed of two semi-lenses, obtained by bisecting an achromatic lens. These semi-lenses are placed at the distance of the two eyes, or at such multiples of that distance as may be necessary to take dissimilar drawings of full-sized or colossal statues, for the purpose of reproducing the statue in the stereoscope. The author described and explained a method by which statues of all sizes, and living bodies, may be reproduced, as it were, and exhibited in three dimensions; and he pointed out the great advantage which the sculptor would derive from the possession of dissimilar drawings of works of art, and from the study of them when viewed in their true relief in the stereoscope.

A Microscopic Stereoscope, with several curious diagrams, were exhibited, and, in particular, the effect of dissimilar drawings, made by the Binocular Camera, of Danneker's statue of Ariadne on the Leopard, when united in the stereoscope. The united image stood out in high relief, as in the original statue.

"Sequel to his Description of a Revolving Valve for Locomotives and other Steam-Engines." By John Anderson, Esq. (late of Cupar), Pratis, Fife. A working model-locomotive fitted with this valve was exhibited in action.

A description of this valve was read to the Society in 1846, and is given in the proceedings of session 1845-46, in the Society's Transactions, Vol. III., App. D., page 62; and a prize of five sovereigns awarded to assist in constructing a working model. That model was now exhibited in action. The valve has a rotatory in place of a reciprocating motion, and Mr. Anderson considers it much more suitable for locomotive steam-engines than the common valves.

"On Improvements in the Roofs and Glazing of Conservatories and Hothouses, with a drawing." By Mr. William Cooper, glass-manufacturer, Aberdeen.

In this paper the author remarks, that the Romans glazed their hothouses with a transparent substance, called *lapis specularis*, a fossil of the class of "talcs," with which they were chiefly supplied from the island of Cyprus, and which is used to this day by lantern-makers; and so good a substitute is it said to have been, that the Emperor Tiberius had cucumbers at his table throughout the whole year. The author gives a description of the magnificent conservatory at Chatsworth, constructed by Decimus Burton, Esq., architect, London, for his Grace the Duke of Devonshire, at a cost of £32,000, and containing 70,000 superficial feet of glass; and such is its extent and convenient arrangement, that three or four carriages have been driven in it at one time. Instead of wooden sash bars, the author recommends wrought-iron bars, galvanized, which are by far the best and cheapest in the end, inasmuch as they require no painting, and are not subject to decay, the galvanized iron being an effectual remedy against the action of oxygen. The expense of copper bars of sufficient strength to bear a great weight of glass (especially during a hurricane, which has been proven to press at a weight of 50 lbs. per superficial inch) entirely precludes its use for conservatories; besides, copper for this purpose is otherwise objectionable, because every drop of water containing oxide of copper carries death to the plants. Glass is now very cheap, and, instead of using panes of glass six inches square, as formerly, puttied close at the joinings, and which causes a drop of water arising from the condensed vapour, and which is injurious to the plants, the author recommends sheet glass from 30 to 60 inches long, and from 6 to 9 inches wide, cut to an elliptic form at the ends and overlapped, and to allow one half-inch of an opening at each joining, exactly at the centre of the elliptic, puttying the remainder across in the usual way; thus allowing breathing room to the plants, and the escape of the superabundant carbonic gas emitted from them.

The author exhibited two drawings of conservatories of moderate dimensions, constructed on the most improved principles, with central coned roofs; the bend of the glass forming an arch, more effectually resists a storm. The air is heated by means of tanks and hot-water pipes, being the nearest approximation of artificial to natural heat. The best stones for pavement are found on the estate of Lindsay Carnegie, Esq. of Kimblethmount, near Arbroath. Glass ventilators are used instead of the old method of ventilation by raising the sashes, which is attended with risk and inconvenience, and often with serious injury to the plants.

For some purposes, and for angular roofs attached to garden walls, the author recommends the use of rough plate glass, $\frac{1}{4}$ or $\frac{3}{8}$ inch thick, on account of its cheapness and durability.

"Description of a Saw-Mill, intended for Colonial use where metal is scarce and wood abundant." By Mr. William Reid Douglas, carpenter to the Right Honourable Lord Torphichen, Calder House, Mid-Calder.

It was stated that this perpendicular saw-mill is particularly adapted for colonial purposes, owing to the small quantity of metal required in its construction; that it is also much simpler and less expensive in its construction than the ones in general use, and is adapted to saw either round or square timber.

The motion is communicated to a shaft, on the one end of which is fixed a fly-wheel, on the other a crank communicating the motion to the working beam, the other end of which is attached to the under part of the saw-frame; on the same shaft is fixed an eccentric, which works a catch on a small ratchet wheel fixed on the end of a wooden roller, on which the rope winds as it draws forward the slide bench, the motion of which can be retarded by the application of pulleys if required.

"Description of a Machine for Cutting down Standing Timber, capable of being used by one man." By Mr. George D. Howell, 1 Young Street, Edinburgh.

The machine is intended to be useful where labour is scarce. The saw being fixed in a frame, admits of one power pressing each way alternately. The body of the machine is so constructed that it may be taken to pieces, and rendered portable.

"Description of an Improved Glazier's Machine." By the same.

This glazing machine, by being secured by the screw underneath, was stated to be less liable to shift, or to jolt, or be unsteady, as when secured with the pins in present use, and, by having the cross bar padded, secures the paint inside from injury by friction.

The common machine, it was stated, could be altered to this plan with comparatively little expense.

THE SOCIETY OF ARTS.

Session 95.

April 10, 1849.

A communication was read by Colonel Baron de Suarcé, "On the Oxalis Crenata," and specimens of the tubers were exhibited.

The Oxalis Crenata has been known to botanists for some years; it is a tuberous plant, the culture of which, however, upon a large scale, has been little practised. The tuber is stated by Baron de Suarcé (who has cultivated about two acres and a half of it, upon his estate in the south of France) to yield a larger amount of nutriment than most of the farinaceous plants which form the basis of human food in our climate. The total weight of the crop obtained from the two acres and a half was ten tons, from which three tons of flour were procured.

From the stems of the plant, which may be cut twice a year, ninety gallons of a strong acid were obtained, which, when mixed with three times its bulk of water, was well adapted for drink. The acid, if fermented, forms a superior vinegar, as, when used for curing or preserving meat, it does not render it hard, or communicate to it a bad flavour. The stem and leaves may be eaten as a salad or spinach.

The flour obtained from the tubers is superior to that from the potato, maize, or buckwheat, making an excellent light bread when mixed in the proportion of one-fourth with wheat-flour.

The Baron concluded his paper by expressing his willingness to make any further communication to the Society on the subject that they might desire; being extremely anxious, with the aid of the Society, to introduce into England the culture of a tuber promising to become a source of food for the lower classes, more valuable, perhaps, than even the potato.

In reply to a series of questions, the Baron stated that the Oxalis Crenata came originally from South America; that it is hardy, unaffected by change of temperature, and grows readily in any soil, it being difficult, when once introduced, to eradicate it.

Dr. Ayres then read a paper "On the importance of the animal refuse of towns as a manure, and the methods of rendering it available to agricultural purposes."

The author commenced his paper by calling attention to the necessity of preserving the animal refuse of towns, and the importance which is attached to it in China, in Flanders, in many departments of France, Tuscany, &c.; and also to the various forms in which it is applied to thè earth. In the neighbourhood of Grenoble, Lyons, and Nice, it is employed in the state in which it is removed from the cesspools. In Flanders, it is diluted with a large quantity of water, and employed as a liquid manure. In China, it is mixed with dried clay and made into cakes; and a manufacture has more recently sprung up in France, which consists in mixing the contents of the cesspools with the calcined mud of rivers, adding some proto-sulphate of iron, and allowing the mixture to become dry.

Having alluded to the importance of this subject in connection with the improvement of the sanatory condition of the towns themselves, and the injurious effects of putrefying matters on the health of the inhabitants of London in particular, by allowing it to be carried into the Thames, there to be tossed about upon the waves, and at each retreat of the tide to be left exposed upon the shores,—he proceeded to call attention to the contents of the cèsspools of London alone, which he calculated would yield not less than 46,500 tons of perfectly dry matter annually; a quantity, according to the estimate of Liebig, sufficient to fertilize, at least, 1,000,000 acres of land, and the monetary value of which cannot be stated at less than £340,000.

Several plans have been proposed for reducing animal refuse to a dry state: viz. the plan employed in France, and patented in England by Mr. Brown; the plan patented by Mr. Higgs; and that for which the author of the present paper has obtained a patent.

The first of these consists in deodorising the animal refuse by a mixture of perchloride of iron, and pyrolignite of iron, then mixing it with calcined river mud, and drying it by exposure to the air.

The second plan, viz. that by Mr. Higgs, is applied to the sewerage, and consists in receiving the sewerage into large tanks or reservoirs, throwing into these reservoirs a quantity of slacked lime, allowing the solid matter to subside, and then, having drawn off the water, the solid deposit is dried in the shaft of a steam-engine. The ammonia which escapes during this process is received into wooden chambers built over the reservoirs, into which a quantity of chlorine gas is disengaged, and thus chloride of ammonia is formed, which condenses on spars stretched across the chambers.

Previous to describing the process patented by the author, he adverted to the value of the animal refuse, by quoting the following extract from Liebig's Agricultural Chemistry:—"On the assumption that the liquid and solid excrements amount on the average to one pound and a half daily, and that the liquid and solid taken together contain 3 per cent. of nitrogen, then in one year they will amount to 547 pounds, containing 14·41 pounds of nitrogen,—a quantity sufficient to yield nitrogen to 800 pounds of wheat, rye, or oats, or 900 pounds of barley. This is much more than is required to manure an acre of land, in order to obtain, with the assistance of the nitrogen of the atmosphere, the richest crops every year. By adopting a system of rotation crops, every town and farm might thus supply itself with manure, which, containing the most nitrogen, contains also the most phosphates. By using at the same time bones, and the lixiviated wood-ashes, animal (domestic animal) excrements might be completely dispensed with on many kinds of soil."—*Liebig*, p. 191.

Not only do the contents of cesspools furnish a manure rich in nitrogen, but one of the richest in the inorganic matters and salts required for the fertilization of the soil. This is shown by the analysis of the ashes of human excreta by Berzelius. The ashes amounted to 15 per cent. of the dried matter, and consisted of—

Phosphate of lime and magnesia, with traces of sulphate of lime...	66·66
Carbonate of soda ...	5·34
Sulphate and phosphate of soda, with some sulphate of potash...	5·34
Soluble silica, from vegetable food ...	10·66
Charcoal ...	12·00
	100·00

The following experiments by Hermbstardt were also quoted, and are of a practical nature:—

Equal plots of ground of the same nature and productiveness were manured with equal weights of different manures in their dry state. The soil, without any manure, yielded threefold the seed sown; manured with dry herbage, old hay, leaves, and other vegetable matters, fivefold; with dry stable-dung, sevenfold; with pigeon-dung, ninefold; with dry horse-dung, tenfold; with extract of urine, twelvefold; with dried blood, and dried night-soil, fourteenfold. So that dried night-soil equals the most powerful animal manures in its fertilizing properties.

The author next proceeded to describe his process, as essentially depending on the fact, that all the gaseous and volatile products of putrefaction are combustible, and may be resolved into the ordinary products of combustion when carried over any incandescent surface, or over or through burning fuel, when mixed with atmospheric air. Thus, ammonia is resolved into nitrogen and water; sulphuretted hydrogen into sulphurous acid and water; carburetted hydrogen into carbonic acid and water; phosphoretted hydrogen into phosphoric acid and water; the volatile organic matters associated with the gases are completely destroyed; carbonic acid alone passes through the fire unchanged. All these gases, with the exception of ammonia and carbonic acid, exist only in very small proportions in putrescent animal matter. It follows from what has been stated, that all the volatile products of putrefaction are thus resolvable into the ordinary products of combustion, which are well known to be innocuous. It suffices to conduct these gases and vapours through a fire, to effect their entire decomposition and destruction.

The apparatus by which this process may be worked is susceptible of many modifications; but that to which the author particularly desired to direct the attention of the Society, consists in drying the animal refuse by the application of either heat obtained from steam-pipes, or otherwise.

ROYAL INSTITUTION.

February 16.

THE DUKE OF NORTHUMBERLAND, PRESIDENT, IN THE CHAIR.

Mr. Grove "On Voltaic Ignition." Mr. Grove introduced his subject by asserting that the only philosophical idea of it was that which regards it as a repulsive power—that, with the single exception of water and other bodies which assumed a crystalline form when about to freeze (a condition which Mr. Grove ascribed to a polar state which these substances then took), all matter expanded by heat. Mr. Grove here referred to the experiments of Fresnel and Saigy on discs in vacuo, and the still more recent researches of Prof. Baden Powell on Newton's rings, as showing the repulsive effect of heat, measured by tints of light. This expansion of matter, so caused, can be communicated to neighbouring bodies. In the case of heat produced by intense chemical action, the effect was ascribed to the physical force of a species of molecular friction on the particles acted on. This chemical force is capable of transfer by the voltaic battery, and the calorific force moves with it. It was proved, by an experiment on a compound wire of silver and platinum, that in proportion to the increase of conducting power, ignition was diminished. Mr. Grove here referred to recent researches of his own, to prove that this calorific action was affected by external causes. The same current was sent through two coils of fine platinum wire, one of which was surrounded by an atmosphere of air, the other by an atmosphere of hydrogen, when it was found that the wire in air became white-hot, while that in hydrogen was not heated. This phenomenon Mr. Grove ascribed either to the mobility of the particles of the hydrogen, or to the vibrations moving away from the vibrating surface, or to the state of the surface itself, hydrogen being, as to radiating power, to air what the colour black is to white. That this cooling effect does not depend on rarefaction, is proved by the intense heat and light produced by the current in vacuo. Mr. Grove then proceeded to show how the chemical force in the battery acted on masses of matter interposed in the circuit. He exhibited, first, the attraction of gold-leaf terminals, and then explained how liquid masses similarly attracted each other, and noticed a remarkable experiment lately performed by him with M. Gassiot's large battery of 500 cells (Grove's battery): of the two platinum poles, the positive was placed under water, the negative held over it, when a cone of flame issued from the surface of the water towards the negative pole, on the extremity of which a small globule was formed, which fell off as soon as the current was suspended. These facts may serve to explain more clearly the phenomena of the voltaic arc. Mr. Grove then exhibited paper on which the strong disruptive effect of the electric battery had dispersed metallic wires, and he showed that these explosions had always occurred in a line transverse to that of the current. He inferred that, when ignition commenced in the wire, its molecules assumed a transverse polar direction. He stated, that when platinum is ignited by the current under circumstances which admit of the effects being accurately noticed, it contracts, swells, and breaks, and that a lead wire, similarly acted on, becomes divided by a series of transverse facets. In conclusion, Mr. Grove adverted to recent endeavours to obtain voltaic light for practical purposes. After noticing that no greater power of producing light had been obtained since the invention of his nitric acid battery, nine years ago, Mr. Grove stated, that recent calculations led him to believe that, for some purposes, such as the illumination of light-houses, especially where an intermittent light was wanted, and of the interior of large buildings, it might possibly be adopted at no very remote period. He mentioned that the light of 1,440 candles might be obtained at about 4s. per hour; but this concentrated light was not applicable for streets. The whole subject, however, was beset by many mechanical difficulties.

February 23.

W. R. HAMILTON, ESQ., V.P., TREASURER, IN THE CHAIR.

Rev. J. Barlow "On Mr. Philips' Fire Annihilator." The annual destruction of property, to the amount of more than two millions sterling, and the fearful loss of human life, necessitate additional resources against fire. The destructive agent of conflagration is flame. It is flame which occasions violent draught, produces the most intense heat, and most rapidly generates those suffocating vapours which render the burning apartment inaccessible. Mr. Barlow remarked, that the origin and continuance of flame depended on two conditions—firstly, that the combustible material should be raised to, and kept at, a temperature high enough to afford a constant supply of inflammable gas; and secondly, that it should be constantly fed with pure air. The usual remedy against fire is water. But water is able to interfere with the first of these conditions only. Unless the burning substance be so saturated with water that it cannot give out combustible gas, within a very few minutes after it has been set on fire, the heat of the flame first extends, and then ignites other inflammable gases and vapours from various parts of the room; the flames are thus dispersed about the apartments; and by the time that the engine arrives, the contents of the house are frequently consumed. Mr. Philips proposes to subdue flame by effectually disturbing the second condition of its continuance—access of pure air. The object of the Fire Annihilator is to diffuse through the atmosphere (already vitiated by the combustion) of an apartment on fire, a quantity of carbonic gas and steam, and thus render the continuance of flame impossible. These gases and vapours are generated in a portable apparatus, which, when intended for the protection of private dwellings, weighs from twenty to thirty pounds; and the construction is such that the aeriform fluids can be evolved in less than three seconds on touching a spring. When saw-mills, or docks, and large magazines are to be protected, Mr. Philips recommends that larger machines should be stationed at convenient situations. The effects of Mr. Philips' apparatus were exhibited in the lecture-room. A large volume of flame was made to issue from models of a house, a room, and a ship; and these flames were extinguished as soon as the Fire Annihilator was brought to bear upon them. Mr. Barlow remarked, in conclusion, that while the common fire-engine was necessarily tardy, required great power to work it, was liable to be rendered ineffectual by accidental circumstances, and occasioned inevitable damage to furniture, &c., the fire annihilator was always at hand, always ready for use, easily set in action, and that its coming into action when required might be as surely relied on as the discharge of a percussion gun when the trigger was pulled; that it occasioned no injury to furniture; and above all, that though it acted by producing fierce combustion, those who used it need apprehend no injury from it.

MARCH 9.

ADMIRAL SIR E. CODRINGTON, VICE-PRESIDENT, IN THE CHAIR.

Mr. Brodie "On the Chemical Relations of Wax and Fat." A thread of chemical analogy has been discovered, by which the class of wax and fatty bodies is connected with alcohols, acetic acid, and their derivatives. The object of this discourse was to point out and illustrate this analogy. These three groups of bodies comprise members of the same chemical system of alcohol and acids, of the general formulæ, $C_m H_m + 2 O_2$, and $C_m H_m O_4$; which differ solely in the amount of hydrocarbon they contain. The chemical nature of fats was illustrated by margaric acid, $C_{34} H_{34} O_4$, and butter; the nature of wax by bees'-wax, and a peculiar wax from China, probably also an insect secretion. Bees'-wax consists of at least two parts—a free acid, cerotic acid, $C_{54} H_{54} O_4$, and a peculiar body, myricin. The myricin and Chinese wax are perfectly analogous in their constitutions, and are remarkable as being the sources from which two new alcohols, melissin, $C_{60} H_{62} O_2$, and cerotin, $C_{54} H_{56} O^2$, have been derived. There are now six alcohols, of which two are waxes, and one, ethal, a fat. After various illustrations of the relations of these bodies, it was remarked that these chemical analogies suggest the probability that alcohol itself is truly a very fluid form of fat, and that, when solidified, it will appear with the physical characteristics of a fatty body; and also lead us to hope that the day is not distant when wax and fat will be made by the chemist from sugar, as well as alcohol and vinegar; for there is exactly the same kind and the same amount of chemical difference, but in different directions, between fat and alcohol as between fat and wax.

APRIL 20.

W. R. HAMILTON, ESQ., VICE-PRESIDENT, IN THE CHAIR.

Mr. Hunt "On some New Phenomena of Light and Actinism." The chemical change produced in chloride of silver when exposed to the action of the sun's rays, by which powerful chemical affinity is broken up, chlorine liberated and silver in a state of fine division left, was selected as an exemplification of the actinic force, which was the subject of consideration. This chemical change takes place in white light, and hence all those photographic phenomena which have created so much interest have been referred to luminous power. If, however, we examine the conditions of light as analyzed by the prism,—presenting, not seven coloured bands as stated by Sir Isaac Newton, but *nine* as proved by recent experiments,—it is found that these coloured bands possess opposite properties. For instance, the chloride of silver will not darken in the mean luminous ray of the spectrum, nor will it darken either at that end which gives the greatest calorific effect, or at the end which is embraced by the lavender ray, usually regarded as representing the most chemically active part; consequently, we find three points in the spectrum which will not produce any change in chloride of silver. Where we have the most light, and at two extremities where the light ceases to affect the human eye, and also laterally, bands are exhibited which show the same physical conditions, and thus it would appear that the *circle of light* is not the agent producing this peculiar alteration. Regarding, as appears natural, the ordinary prismatic spectrum as the representation actually of two spectra consisting of but three colours—red, blue and yellow, which is shown by the reappearance of red light in the blue, and of yellow light in the lavender ray, which blue light appears again at the least refrangible end in the extreme red or crimson ray, we have an explanation of the result above-mentioned, and the want of chemical action is shown to arise from the operation indeed of the most luminous bands. By absorbent media, as coloured glasses and fluids, these results were more fully explained. The most remarkable results have, however, been lately obtained by the use of coloured media; and it has been shown that every luminous ray, independent of colour, may be made to protect chloride of silver from that chemical change which is induced by the direct action of diffused daylight,—the portion upon which those rays fall being actually preserved as a white space, every other part being blackened. It was contended that no hypothesis of interference would explain this result, which more decidedly proved than had hitherto been done, the wide difference between the phenomena of light and actinism. The fact that luminous effect—phosphorescence—was produced by the blue rays of the spectrum appears to oppose this view; but when we find that almost any variety of glass prevents this phenomenon, and that in like manner electricity was interrupted, it appears more rational to refer phosphorescent phenomena to some peculiar electric excitation. The action of the solar rays on the development of vegetable life was then explained, and the following conclusions suggested as the explanation of experimental results frequently repeated:—1. *Germination*, which will take place in the dark, is quickened by the actinic force, and retarded and often stopped by the luminous power.—2. *Lignification.* The decomposition of carbonic acid by the plant is due to some excitement of luminous power, and is stopped by the actinic force.—3. *Formation of Chlorophyle.* Due entirely to the luminous rays.—4. *Flowering and Fruiting.* Dependent upon the action of the thermic or parathermic rays of the spectrum, as distinguished from both the luminous and actinic forces.—5. *Motion of Plants.* Bending to the blue light and receding from the red, proving the excitement of actinic force.

INSTITUTION OF BRITISH ARCHITECTS.

APRIL 16.

S. SMIRKE, ESQ., VICE-PRESIDENT, IN THE CHAIR.

The Chairman announced that the Royal Gold Medal of the Institute, for the year 1848, was awarded to the Signor Cavaliere Canina of Rome, as the historian of Architecture from the earliest period, and for his antiquarian researches, he having published a series of important works on the various styles of art, and likewise on the tombs of Etruria, the cities of Latium, and other antique remains.

The report of the Council relative to the competition for the "Soane Medallion" and the "Medal of the Institute" was read and adopted, when the author of the successful essay on Palladian Art was announced to be Mr. W. Papworth.

A paper was read descriptive of the hollow brick ceiling recently turned over St. George's Hall, Liverpool, by Robert Rawlinson, Esq.—Having stated that it had been the intention of the late Mr. H. L. Elmes, the architect of this building, to construct the ceiling with patent compressed bricks, Mr. Rawlinson observed, that he, in using the hollow bricks, had only adopted a mode of construction known to the ancients, and also applied to some of the early Christian churches in Italy, and in buildings of a more recent date. He stated that, although not much in use of late years, these hollow bricks are now likely to be more generally applied, as, owing to a relaxation of the excise laws and the application of machinery, they can be manufactured at a less cost than solid bricks—while they possess the advantage of being lighter. It has been suggested, too, that the hollow bricks may be economically applied in the construction of the partition and external walls of cottages and other buildings, with the advantage of combining dryness with facility of ventilation. The construction of the arch in question was of some importance from its size, the span being sixty-eight feet, and its thickness one foot. The bricks used by Mr. Rawlinson were twelve inches in length, and four inches square, with a longitudinal perforation two inches in diameter. The weight and cost of the arch thus constructed was one-fourth less than they would have been had solid bricks been used. The work was set in mortar (formed of Halkin lime used fresh and made in a steam-mill), with the exception of five feet on each side of the key, which is set in cement. The spandril walls are similarly constructed, at distances of four feet six inches, with circular openings which afford a passage along the sides. On removing the centerings, the arch was found to have deflected only three-eighths of an inch.

MONTHLY NOTES.

BALDWIN'S PROCESS FOR SPLITTING PAPER.—We lately noticed the discovery of a process whereby the thinnest sheets of paper can be accurately split or divided into two regular films, and referred to one of the schemes which had been hazarded in the prints of the day, as likely to effect the object in question.* Since that date we have been favoured by the originator, Mr. Baldwin, of 33 Regent Street, Lambeth, London, with some remarks upon the process. Nearly all the newspaper statements have pointed to the application of the plan, to the splitting of bank notes—an equivocal species of employment which Mr. Baldwin certainly never contemplated. His idea of the plan arose entirely from the fact of many valuable engravings having letterpress, and sometimes another engraving on the back—in both which cases they could not be conveniently mounted, as in one case the letterpress would show through to the injury of the impression, and in the other, one of the prints must be sacrificed. As a print-mounter, the inventor has frequently found, amongst collections of engravings which have been made for the purpose of illustrating books, that serious inconvenience was thus occasioned; but, by the adoption of his process, two distinct sheets may be obtained, and such woodcuts as are issued in the *Art Journal*, *Illustrated London News*, and other pictorial publications, may be preserved without the drawbacks to which we have alluded. Very many most important books possess illustrations of a valuable character, which are unfortunately spoiled for mounting in the ordinary way. In *Larater's Physiognomy*, for example, illustrated by some of our best engravers, as Holloway, Hall, Trotter, and others, the prints are in many cases back to back. Another book of much greater value is the *Heroologia*—as also the *Lives of the Kings and Queens of England*, with portraits by Elstracke, Delaram, S. Pass, and others, and many woodcuts by Albert Durer, and his fellow-engravers of the old school—all of which were sacrificed or injured in mounting by the old method. The only motive for splitting a bank note was, that the note paper is very thin and tough—affording, therefore, a good subject for the trial.

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* Page 287, Vol. I.

Royal Scottish Society of Arts Prize List.—The Prize List of this valuable Society, as will have been seen from our advertising pages, has just been issued for Session 1849-50. It is, with slight exceptions, the same as the lists of previous years, containing offers of awards for discoveries or improvements throughout a vast range of arts and processes, and deserves the best consideration of such of our readers as are in a position to devote any leisure moments to the investigation of the numerous branches of mechanism and chemistry, to which it more immediately bears reference. It is not, however, to be understood, that prizes will be given only for communications within the scope of the heads laid down in the published list; *any* important improvement will receive its share of attention at the Society's hands, although it may not come directly under the subjects named. The pages of this *Journal*, for the past year, are tolerably fair evidence that the labours of the Society have at least resulted in rousing talent, which, but for such attractive calls, might still be slumbering.

Railway Signalling.—Amongst the innumerable propositions which come before us, a correspondent in Edinburgh writes—"Some time ago a percussion powder was proposed to be placed on the rails to prevent collision during a fog, by giving notice for the stoppage of trains during a fog. I propose to apply the same powder *internally*, as a signal from the guard to the driver; and, in order to do this, let each carriage be fitted with a metal tube placed within reach of the guard, and terminating about two inches above the rail, immediately before the carriage-wheel. Each guard is to be provided with a few percussion balls, which may be dropped down the tube for explosion when necessary.

Stock and Son's Self-Acting Water Closet.—The peculiarity in this arrangement is, that any pressure upon the seat acts upon a valve beneath it, so as to permit the flow of water to a small ball-valve cistern placed above. When the pressure is removed, this water is allowed to descend to the basin, by the return action of the seat-valve. No cranks or wires are required, the water being simply conveyed by a small leaden pipe.

Self-Heating Shot for War Purposes.—We saw, the other day, in the establishment of Mr. Field, tinplate worker, Argyle Street, a peculiar and apparently most valuable mode of obtaining red-hot shot for large guns. It is the invention of Mr. James Scouller, the foreman in Mr. Field's workshop, and consists in the filling the hollow shot with a highly combustible powder, the composition of which we are not yet at liberty to make public. Two or three fuse-holes are made in the shot, so that, when fired from the piece, ignition takes place, and the shot is made red-hot before it arrives at its destination. In the trial we saw, the shot, which was about 2½ inches diameter, was simply laid on the ground, and the composition was ignited by a light applied to the fuse-hole. Violent combustion immediately ensued—liquid fire appeared to stream from its three fuse-holes, and the metal became quite red-hot in a few seconds. The inventor states, that when fired from the gun, a red heat will be attained in twenty seconds from leaving its mouth. The composition will also burn under water. It is easily made, and there is little doubt as to its efficiency for war purposes, in place of the present expensive and troublesome system of heating, the shot being put into the gun in a cold state, as with ordinary solid balls.

Bertram's Economic Hot-Water Apparatus.—Since our notice of this apparatus at page 15 of our April Number, Mr. Bertram has fitted up a working model in his works in Mitchell Street. This model exhibits the correct action of the arrangement very clearly. As the water in the boiler is heated to the boiling point, it flows over, and its place is supplied by a corresponding quantity of cold water, which continually keeps the tubular grate-bars at a low temperature. In the model, the water is heated by a cast-iron heater placed in the fire-box; and when the water is thus elevated to the top of the safety-pipe, so as to boil over for some minutes, and the heater is withdrawn, the finger may be held on the bottom and lower front bars without injury, showing that these parts have been kept quite cool, whilst the conveyance-pipe for the hot water could not be touched at a distance of four feet from the boiler. The safety-pipe being carried up just above the height to which the water column ought to rise, in the regular action of working, there is no possibility of danger, as the water would immediately flow from it, and diminish the pressure at once. This pipe is therefore not a mere indicator, as might perhaps be conjectured from our last month's remarks, but a positive preventor of accident.

Green's Flushing Syphon Basin for Water-Closets.—Mr. Green of the Imperial Potteries, Lambeth, has shown us some important improvements in this branch of domestic machinery. The rim of the basin has a hollow lip turned downwards, passing all round; and through this, the water rushes with undiminished power to the bottom. It is worked without cranks or wires, the well-known sources of derangement, and any number of them may be attached to one supply cistern, the only additional cost being a length of half-inch lead pipe. It is, besides, purely self-acting.

Bewick, the Wood Engraver.—While speaking of the English school, I must not omit to notice a truly original genius, who, though not a painter, was an artist of the highest order in his way. I mean Thomas Bewick, the admirable designer and engraver on wood. His works, indeed, are of the smallest dimensions; but this makes it only the more surprising, that so much of interest could be comprised within such little spaces. The woodcuts that illustrate his books of natural history may be studied with advantage by the most ambitious votary of the highest classes of art—filled as they are with a most refined taste and feeling for nature; and though often representing the most ordinary objects, yet never, in a single instance, degenerating into commonplace. The charming vignettes that ornament these books abound in incidents from real life, diversified by genuine, but not extravagant humour, as well as by the truest pathos,—of which the single figure of a shipwrecked sailor saying his prayers on a rock, with the waves rising around him, is an instance. There is often in these little things a deep meaning, that places his art on a level with styles which the world is apt to consider as greatly above it; in proof of which I would mention the party of boys playing at soldiers among graves, and mounted on a row of upright tombstones for horses; while for quaint humour, extracted from a very simple source, may be noticed a procession of geese which have just waddled through a stream, while their line of march is continued by a row of stepping-stones. The student of landscape can never consult the works of Bewick without improvement. The backgrounds to the figures of his quadrupeds and his birds—and his vignettes, have a charm of nature quite his own. He gives us in these every season of the year, and very often winter—snow-pieces, or groups skating. He is equally true in his little home scenes, his farm-yards and cottages, as in his wild coast scenery, with flocks of sea-birds wheeling round the rocks. In one of these subjects, there stands a ruined church, towards which the sea has encroached, the rising tide threatening to submerge a tombstone raised "to perpetuate the memory," &c. Bewick resembles Hogarth in this, that his illustrations of the stories of others are not to be compared with his own inventions. His feeling for the beauties of nature, as they were impressed on him directly, and not at second-hand, is akin to the feeling of Burns; and his own designs remind me, therefore, much more of Burns than the few which he made from the poet.—*Professor Leslie's Lectures on Painting.*

Richmond's Engine Counter.—Since our notes upon this "Engine Counter" at page 20, *ante*, the inventor, Mr. Richmond of Bow, has forwarded us sketches of the instrument. A circular case contains a train of wheel-work, showing three small dials enclosed within a larger graduated circle, set out into 100 divisions. An index carried by the central spindle, counts each individual stroke or revolution of the engine upon this circle. At each revolution of this index, the small index of the first of the three inner dials moves one division, and registers up to 1000. When this number is reached, the index on the second small dial points to 1000, this registers up to 100,000; and the third, in like manner, carries out the system to 1,000,000. The number of strokes are at once seen on the several dials, and may be read off just as they stand; and this reading is facilitated by causing all the hands to revolve in the same direction, so that there are no reversed circles of figures. The first movement is given by a sliding bar and fixed spring, in place of the double pallet, so that one tooth only can be moved forward at each revolution, however quick may be the speed of the engine. By the addition of another small dial, the registration may be effected up to 10,000,000. The counter was introduced to the notice of the Institute of Civil Engineers in January, 1848, and elicited the good opinions of the president and several engineers, who were in the habit of applying counters.

Calcined Granite as a Material for Fictile Purposes.—Experiments have lately been made by Mr. Archibald M'Donald, at the Seaton Pottery, Aberdeen, upon calcined granite as a substitute for clay in the manufacture of pipes and other earthenware articles. He states, in a note to us, that the material stands a strong fire, and is not affected by transitions from heat to cold. The native colour of the stone can be nearly retained in the formation of busts, statues, vases, urns, and general pottery, as also in chimney-pieces, spouts, and chimney-cans. In such articles as are intended to withstand the effects of great heat, where an extract only of the stone is used, the colour cannot be kept so well—as, for example, retorts, crucibles, and melting pots; but any preparation of the material, when once properly finished, may be heated to whiteness without injury. Up to the present time, the experimental trials have been carried on under every disadvantage, as, from the circumstances of the inventor, the preparation of the material has been entirely performed at spare moments in his own dwelling-house, the articles being afterwards carried to the pottery to be fired. As the existing furnaces would not fuse a suitable glaze, the ordinary brown ware glaze had to be used, thus spoiling the true tint of the stone. Mr. M'Donald is also the possessor of a new composition for coating ship's bottoms, as a preservative. It is a transparent black, not brittle, but very adhesive, and is said to destroy marine insects and prevent vegetable deposit.

Biram's Miner's Lamp.—We have before us three well-executed woodcuts of a new miner's lamp, the invention of Mr. Biram of Wentworth, Rotherham, whose inventions in mine ventilation and propelling are so well known. The oil vessel is of the D shape, fitting accurately into the bottom of a similarly shaped metallic case, the flat side of which is a framed door, sliding in vertical grooves. The wick is of the flat kind, and is elevated or depressed by a rack, the spindle of which projects through the side of the case, and is fitted with an adjusting button outside. To clear the wick of any carbonized portions, a strong jointed wire is passed through the case on a level with the wick tube. The chimney is cylindrical, and has an opening at the top, into which slides a piece of wire gauze, and over all is a sliding loose top securing the whole, and preventing the blowing down of air. The door on the flat side of the case for emitting light, may be either wire gauze or talc. When the lamp is placed in an inflammable atmosphere, the air, being admitted through the door only, immediately ignites and burns within the wire gauze with a slight blue flame. As any further supply of oxygen is thereby cut off from the wick, the light, unless at once withdrawn, would be extinguished with no inconvenience to the party using it, except placing him in darkness.

Wrighton's Elastic Screw Coupling for Railway Carriages.—This is an ingenious adaptation of springs to the screw-coupling apparatus of Mr. Booth, being intended as a substitute for the usual buffing and draw-spring apparatus. The thin ends of the right and left screw-spindle are tapped into the ends of two tubes, bored out a little wider than the diameter of the screws, except at one end, which acts as a nut. These tubes pass through cross-pieces, in which they slide, but are prevented from turning round by a flat on the side; and between each cross-piece, and a flange at the opposite end of the tube, is placed a helical spring, coiled upon the tube. Each cross-piece has two pins on its ends, to which are attached the double draw-links, for hooking on to the buffer draw-hooks. When the coupling is tightened up in the usual way, by the weighted pendant lever in the centre of the screw-spindle, all the strain is transmitted through the two helical springs, which, by their elasticity, prevent any sudden blow or shock, the tubes sliding through their cross-pieces, as the springs are extended or compressed. The apparatus presents a very neat combination of a coupling and buffing, and draw-spring apparatus in one arrangement, and will be found very advantageous in its application to waggons with dead draw-hooks and solid buffer-ends. In some late trials with it on the Eastern Union Railway, two trucks, with dead draw-hooks and solid buffer-ends, were connected by one of the couplings, and attached to one of Slaughter & Co.'s 15-inch cylinder luggage engines, with as many loaded trucks behind as the engine could draw. This train was drawn and shunted about at the Ipswich station, without causing any shock between the coupled trucks, although frequently started and stopped in a sudden manner.

The Duchess of Argyle Steamer.—A new river-boat, with this name, has latterly attracted a good deal of attention on the Clyde. She was originally built as a pleasure-yacht for Mr. Assheton Smith, who intends to resume his occupation of the *Fire Queen*, lately plying between Glasgow and Ayr. The *Duchess* is of very beautiful mould—long and sharp. She was built by Mr. Napier, her engines being made by Penn. They are oscillators, and are, we believe, the only pair of the kind at present on the river. Doubtless, their smooth and efficient action will lead to the more extended adoption of this class of engines, which are certainly well fitted to supersede the irregular direct-action single-steeple engine, for which the Clyde is so notorious. The absence of all vibration in this boat is a matter for general remark, the engines giving a steady, smooth, straightforward pull, avoiding the jerking motion so disagreeable to most passengers. The *Fire Queen* is now lying at Mr. Napier's dock for a complete overhaul, in preparation for Mr. Smith.

Suter's Improved Scratch-Brush.—Mr. Samuel Suter, of Birmingham, has lately registered an improved form of wire scratch-brush, used by workers in precious metals. The ordinary brush now used has both ends alike, forming a sort of double brush. This shape is attended with several disadvantages, amongst which are an unsightly appearance, difficulty of attaching to the chuck, and great waste in using. The new brush may be used without altering the chuck or the lathe; but it is best applied by attaching a circular metal plate to the end of the chuck, with the requisite number of holes pierced in a straight line with the groove in the chuck, just sufficient to admit the brush to pass easily through. By this plan, a complete bearing throughout the whole length of the chuck is obtained, and the brush may be used down to the extremity, saving one-fourth of the material, as compared with the old arrangement. In place of forming the opposite end of the brush of loose wires, the whole are soldered together to form a button, so that none can give way until quite worn down.

Navigation of the Arctic Regions.—Commander Joseph West, an officer of long standing, has proposed a plan of fitting a steam-vessel with ice-hammer and ice-saws, to be worked by the shaft of the engine, for the purpose of navigating the polar regions. The projection is applicable to either screw or paddle-wheel steamers, and is thus explained:—A semicircular cogged plate is fixed on the shaft, which connects itself with an elevating bar, fixed to the end of a sway-beam, the fulcrum being in a crank on the bow of the vessel, at the fore-end of the sway-beam, where the ice-hammer is hung, which, by the connection of the cogs, is raised eight feet at every revolution. It is thrown out of gear when they disconnect, the hammer then falls, and is again raised when the cogs connect. The hammers are from fifteen to twenty hundred weight, working alternately on each side before the stem, and are capable of breaking through ice four or five feet thick; thus enabling a vessel so fitted to approximate much nearer to the supposed position of Sir John Franklin's ships than can be done by the present means,—as the above application can be fitted to any steam-vessel at a trifling expense compared with the object to be obtained. The invention is as simple as it appears to us to be practicable; and we trust that the Admiralty will appreciate the value of the plan, and the motives which actuated the gallant projector, by despatching a vessel so fitted at once on the perilous tract of the almost despaired-of northern navigators.—*United Service Gazette.*

Governors in Screw Vessels.—The principle of this apparatus is the same as that of the land engines, being a machine for controlling the throttle-valve, as occasion requires. Two heavy balls are suspended by means of arms to an axis revolving with the engines. The upper ends of these arms are jointed to the axis, and therefore, as the axis rotates, the balls will fly out from it; and their distance from the axis will depend on the velocity. The arms by which the balls are suspended are connected with rods, which give motion to the throttle-valve, and are so arranged, that as the engines move faster, and therefore the balls fly out farther, the valve shall begin to close; and if the engine relax in its speed, and the balls droop towards the revolving axis, the valve will open. Governors are sometimes fitted to screw-steamers of light draught of water, to limit the supply of steam to the cylinders when the ship pitches. For, since the propeller is at one extremity of the vessel, it will at times, by the pitching of the ship, be performing its revolutions in the air: the engines will then be relieved of their load; and if the supply of steam were not reduced, they would fly off at a great velocity, which would again be checked as the stern of the vessel became immersed in the water. This would be detrimental to the machinery. The governor is so adjusted, that when the speed of the engines is about 40 per cent. above what ought to be their maximum, the throttle-valve closes, and admits no more steam till the revolutions decrease, and thus lessen the centrifugal force acting on the balls.—*The Marine Steam-Engine.*

Novelty in Decoration.—A peculiar method of decoration, suitable for the interiors of apartments, has been invented by a Miss Wallace, who is stated to be a lady of fortune. It consists of a plan of colouring and gilding the interior of glass tubes, for the purpose of being applied as a decoration in the way of beadings. The idea offers an improvement of considerable importance, for the enrichments thus produced are most elegantly chaste and beautiful. The introduction of this principle of decoration will add an important extension to the present system of ornamentation.

Silvering Glass by Gun-Cotton.—A solution of gun-cotton, in a caustic ley, possesses the property of precipitating silver from its solutions in a pure metallic form. If a few drops of a solution of nitrate of silver are poured into it, adding ammonia until the oxide of silver, formed, is re-dissolved (the mixture being heated gradually in a water-bath), it assumes a deep brown colour and effervesces, precipitating the whole of the silver on the sides of the vessel. This discovery is by M. Vohl. In effect, the mirrors thus produced are said to excel those of Mr. Drayton.

Method of Working Marine Engines without Cylinder Covers, in case they are broken by any accident.—It can be effected in this way. Let the broken cover be removed, and the upper steam-port blocked up with a piece of wood, so shaped as to prevent its being forced inwards towards the slide by the pressure of the atmosphere: the orifice is made steam-tight by interposing fear-nought between the wood and the edges of the port. The wood must be kept in its place by two shores, one on each side of the piston-rod, pressing with one end against the wood, and with the other against the opposite side of the cylinder. The steam will be admitted, therefore, to the *under* surface of the piston, but not to the *upper* surface; the upper surface will be acted on by the atmosphere alone. Now, since the pressure to which the steam is raised is considerably above that of the atmosphere, the piston will be forced up against the resistance the air exerts; and, on creating a vacuum underneath the piston, it will be forced down by the atmosphere. To prevent irregularity, we should not create too good a vacuum; thus, if the steam have a pressure of 10 lbs. above that of the atmosphere, we have an effective upward pressure of 10 lbs., and consequently the downward pressure should be about 10 lbs. But the pressure of the atmosphere is 15 lbs.; hence we may have a back pressure of 5 lbs., arising from the uncondensed steam, or a deficiency from a vacuum amounting to 10 inches of mercury; and since a perfect vacuum amounts to 30 inches, the height of the barometer-guage should be about 20 inches. In most engines this precaution is unnecessary, and need only be used when unpleasant jerks are experienced as the wheels rotate. This method has been tried very successfully in H.M.S. *Bee*, which has only one engine, and where, in consequence, it was most likely to fail, on account of the difficulty of turning the centers. The vessel's rate was found to be about two-thirds her ordinary speed. If the engines be fitted with Seaward's slides, we need only detach the upper slides on the steam and vacuum sides when covering the upper ports.—*The Marine Steam-Engine.*

Waymouth's Terrestrial Globe.—Mr. Waymouth of Nailsea, near Bristol, has forwarded us a sketch of an improved terrestrial globe, lately registered by him. The portions representing the water are left smooth, as in the ordinary globes—whilst the land, whose limits they bound, is in considerable relief, being embossed so as to stand up from the level of the water. In this way the globe bears a truer resemblance to nature than when colour alone is used to show the general contour of the parts. It is intended to be moulded in gutta percha or other suitable plastic material, by means of metallic moulds, engraved to produce the required relief. For teachers in elementary schools, or for the instruction of the blind, we should suppose this species of globe to be peculiarly applicable.

Government War-Steamers from the Clyde.—Within the last few days, two large war-steamers have been launched in the Clyde for the Government service. Not long ago, the *Greenock* made her first appearance in the river at Greenock, where she was built by Messrs. Scott and Sinclair; and now, just as we write, the *Simoom* has been launched by Mr. Robert Napier, from his yard at Govan. The latter vessel is well known from her long standing in the building-yard, several years having elapsed since she was first laid down. This delay, arising from the want of determination on the part of the Admiralty, has at length been terminated by an order for the fitting up of the vessel as a screw-steamer, so that she may now be expected to be ready for service at an early date.

ENGLISH PATENTS.

Sealed from 20th April, 1849, to 16th May, 1849.

Charles Alexander Broquette, Rue Neuve, St. Nicholas, St. Martin, France, chemist, —"Improvements in printing and dyeing fibrous and other materials."—April 21st.

William Kilner, Sheffield, engraver,—"Improvements in manufacturing railway and other axles and wheels, and in machinery to be employed in such manufacture."—24th.

Lewis Vernet, Buenos Ayres,—"A method of preserving from destruction by worms, insects, decay, and fire, certain vegetable and animal substances."—24th.

Thomas Harcourt Thompson, Blackheath-hill, civil engineer,—"Certain improvements in apparatus for preventing the rise of effluvium from drains, sewers, cesspools, and other places, and in apparatus and machinery for regulating the level of waters in rivers, reservoirs, and canals."—26th.

George Simpson, Newington-butts, chemist, and Thomas Forster, of Streatham, manufacturer,—"Improvements in manufacturing or treating solvents of india-rubber, and of other gums or substances."—26th.

John Barsham, Chelmsford, Essex, manufacturer,—"Improvements in separating the fibre from cocoa-nut husks."—26th.

Charles Iles, Bordesley Works, Birmingham, machinist,—"Improvements in manufacturing picture-frames, inkstands, and other articles in dies or moulds; also in producing ornamental surfaces."—26th.

William Falconbridge, Long-lane, Bermondsey, Surrey,—"Improvements in the manufacture of hose, pipes, driving-bands, and valves for atmospheric railways."—26th.

Bartholomew Beniowski, Bow-street, Covent Garden, major in the late Polish army,—"Improvements in the apparatus for and process of printing."—26th.

Robert Oxland, Plymouth, chemist, and John Oxland, same place, chemist,—"Improvements in the manufacture of sugar."—26th.

William Henry Burke, Tottenham, manufacturer,—"Improvements in the manufacture of air-proof and waterproof fabrics, and in the preparation of caoutchouc and gutta percha, either alone or in combination with other materials, the same being applicable to articles of wearing apparel, bands, straps, and other similar useful purposes."—26th.

John Horsley, Ryde, Isle of Wight, practical chemist,—"Certain improvements in preventing incrustation in steam and other boilers; also for purifying, filtering, and otherwise rendering water fit for drinkable purposes."—26th.

Alphonse Garnier, late of Paris, now of South-street, Finsbury, merchant,—"Certain improvements in extracting and preparing colouring matter from orchil."—(Being a communication.)—28th.

James Wilson, Old Bond-street, tailor,—"Improvements in trusses."—May 1st.

James Godfrey Wilson, Millman's-row, Chelsea, engineer,—"Certain improvements in the manufacture of glass, and in machinery and apparatus connected therewith."—1st.

Alexander Munkittrich, Manchester, merchant,—"An improved composition of matter, which is applicable, as a substitute for oil, to the lubrication of machinery, and for other purposes."—(Being a communication.)—1st.

John Dalton, Hollingworth, Cheshire. calico-printer,—"A certain improvement or certain improvements in printing calicoes and other surfaces."—1st.

Samson Wooller, Bradford, York, manufacturer,—"Certain improvements in machinery or apparatus for weaving."—3d.

Thomas Wentworth Buller, Sussex Gardens, Hyde Park, Middlesex, Esq.,—"Improvements in the manufacture of earthenware."—3d.

Matthew Kennedy, Manchester, cotton-spinner,—"Certain improvements in the method of packing cops of cotton and other fibrous materials, and in the apparatus connected therewith."—3d.

Thomas Whaley, Chorley, Lancaster, coal proprietor, and Richard Ashton Lightoller, same place, cotton-spinner,—"Certain improvements in machinery or apparatus for manufacturing bricks and tiles from clay or other plastic materials."—3d.

William Newton, Chancery-lane, civil engineer,—"Improvements in the jacquard machine."—(Being a communication.)—5th.

George Edmond Donisthorpe, and John Whitehead, Leeds, manufacturers,—"Improvements in preparing, combing, and heckling fibrous matters."—8th.

Samuel Wilkes, Wednesbury Heath, Wolverhampton, brassfounder,—"Improvements in the manufacture of knobs, handles, and spindles for the same, for doors and other purposes, and improvements in locks."—8th.

Robert Sutcliffe, Idle, near Bradford, York, cotton-spinner,—"Improvements in machinery for spinning cotton, silk, and other fibrous substances."—8th.

George Henry Dodge, Manchester, manufacturer,—"Certain improvements in machinery for spinning and doubling cotton yarn and other fibrous materials, and in machinery or apparatus for winding, reeling, balling, and spooling such substances when spun."—10th.

Charlotte Smith, wife of Jabez Smith, Bedford,—"Improvements in certain articles of wearing apparel."—14th.

Samuel Allport, Birmingham, gun-maker,—"A certain improved method of making or manufacturing a certain part or parts of looms used in weaving."—14th.

William Phillips Parker, 48 Lime-street, London, gent.,—"Improvements in the construction of piano-fortes."—(Being a communication.)—15th.

John Thom, Ardwick, Manchester, calico-printer,—"Improvements in cleansing, scouring, or bleaching silk, woollen, cotton, and other woven fabrics and yarns, and in ageing fabrics and yarns when printed."—15th.

Henry Bessemer, Baxter-house, Old Saint Pancras-road, engineer, and John Sharp Cromartie Heywood, Islington, Middlesex,—"Improvements in expressing and treating oils, and in the manufacture of varnishes, pigments, and paints."—15th.

Moses Poole, London, gent.,—"Improvements in apparatus for drawing fluids from the human or animal body."—(Being a communication.)—15th.

Louis Alfred De Chatanvillard, Rue St. Lazare, France, gent.,—"Improvements in fire-arms, cartridges, bullets, bayonets, and ordnance."—(Being a communication.)—15th.

IRISH PATENTS.

Sealed from 20th April, 1849, to 20th May, 1849.

Felix Alexander Testud de Beauregard, 17 Rue St. Quentin, Paris, engineer,—"Improvements in generating steam, and in the means of obtaining power from steam-engines."—April 27th.

Thomas John Knowlys, Heysham Tower, Lancaster, and William Fillis, Shirley, Hants, mechanician,—"Improvements in generating, indicating, and applying heat."—May 10th.

Samuel Brown. the younger, Lambeth, Surrey, engineer,—"Improved apparatuses for measuring and registering the flow of liquids and substances in a running state, which apparatuses are in part also applicable to motive purposes."—15th.

John Smith, Hare Craig, Dundee, factor to Lord Douglas of Douglas,—"Improvements in the manufacture of flour, applicable in the making of bread, biscuit, and pastry."—18th.

SCOTCH PATENTS.

Sealed from 21st April, 1849, to 22d May, 1849.

Meyer Jacobs, Spitalfields, Middlesex, gentleman,—"Certain improvements in the manufacture, stamping, and treatment generally of woven fabrics of all kinds."—April 25th.

James Roose, Darlaston, Stafford, tube manufacturer, and William Haden Richardson, the younger, same place, tube manufacturer,—"Improvements in the manufacture of tubing."—30th.

Robert Oxland, Plymouth, chemist, and John Oxland, same place, chemist,—"Improvements in the manufacture of sugar."—May 4th.

Frederick Steiner, Hyndburn, Accrington, Lancaster, Turkey-red dyer,—"Improved processes and apparatus to be used in the Turkey-red dye on cotton and its fabrics."—7th.

John Dalton, Hollingsworth, Chester, calico-printer,—"A certain improvement, or certain improvements, in printing calicoes and other surfaçes."—9th.

Alexander Munkittrick, Manchester, Lancaster, merchant,—"An improved composition of matter, which is applicable as a substitute for oil to the lubrication of machinery, and for other purposes."—(Communication.)—10th.

James Anderson, Abbotford Place, Glasgow, starch manufacturer,—"A certain improved mode of separating different qualities of potatoes and other vegetables."—10th.

Alexander Swan, Kirkaldy, Fife, manufacturer,—"Improvements in heating apparatus, and in applying hot and warm air to manufacturing and other purposes where the same are required."—14th.

Samuel Adams, West Bromwich, Stafford, organist,—"Improvements in mills for grinding."—16th.

Daniel Miller, civil engineer, St. George's Road, Glasgow,—"Certain improvements in the mode of drawing ships up an inclined plane out of water," for which mode a patent was granted to the late Thomas Morton of Leith, shipbuilder, on the 23d day of March, 1819, and which mode has been commonly known as "Morton's Slip."—21st.

Alphonse Garnier, Paris, Republic of France, now of South-street, Finsbury, Middlesex, merchant,—"Certain improvements in extracting and preparing colouring matter from orchil."—21st.

Rees Reece, St. John-street, Smithfield, and Astley Paston Price, Margate, Kent, chemists,—"Improvements in the manufacture and refining of sugar or saccharine matters."—21st.

DESIGNS FOR ARTICLES OF UTILITY.

Registered from 18th April, 1849, to 17th May, 1849.

April 19th,	No. 1853.	Samuel Suter, Birmingham,—"Scratch Brush."
—	1854.	Henry Woodfall, Foot's Cray, paper-maker,—"Watermark to be applied to writing paper." (To be called the diagonal-lined paper.)
20th,	1855.	John Classon, Blackhall-place, Dublin,—"Denoter of time."
21st,	1856.	James Kean, Sunderland,—"Machine for making bricks and tiles."
23d,	1857.	Henry Field, Glasgow,—"Gas-heater for baths."
—	1858.	Richard Hornsby, Lincoln, agricultural implement maker,—"Portable farm-engine boiler."
24th,	1859.	Joseph W. Schlesinger, Clement's-lane, London,—"Revolving blotter."
25th,	1860.	Thomas Key, Charing-cross,—"Compensation valve-rod for cornet-à-pistons, trumpets, horns," &c.
—	1861.	John Scott, Tixall, Staffordshire,—"Remington and Scott's bridge."
—	1862.	James Phillips and George Hunt, Birmingham,—"Shell back of wood for a button."
26th,	1863.	John Goodman, M.R.C.S., Manchester,—"Hydro vapour bath."
—	1864.	Samuel Grew and James Crawford, Rugby,—"Cramp for coupling and uncoupling railway carriages."
27th,	1865.	Samuel Reston, Aldersgate-street,—"Life-preserver braces, with air-tight mouth-pieces attached—adapted for other uses."
—	1866.	Samuel Fox, Gracechurch-street,—"Telescopic pencil or pen-holder."
28th,	1867.	William Breynton, Norfolk-street, Strand,—"Portable oven."
—	1868.	Michael H. Crichton, Edinburgh,—"Apparatus for securely holding brooches."
—	1869.	M'Adam, Brothers, and Co., Soho Foundry, Belfast,—"Beater or scutcher for dressing flax and other fibrous plants from the straw, and separating the fibre from the woody parts."
—	1870.	Robert Leslie, 39 North Frederick-street, Edinburgh,—"Cutting machine."
30th,	1871.	James Grafftey, Sydney-alley, Coventry-street,—"Fastening for shirt-collars, garments," &c.
—	1872.	Meyer, Joseph, and Meyer, 21 and 24 Bow-lane, umbrella and parasol manufacturers,—"Parasol Parisienne."
May 2d,	1873.	James W. Blackburn, Cheapside,—"Zetetique prize shirt."
—	1874.	Josh. Guise, Margaret-street, Wilmington-square,—"Gas-burner and glass-holder."
—	1875.	Thomas H. Pindar, Cheltenham,—"Combined coat and waist-coat."
3d,	1876.	Thomas Stuckey, Turner-street, Commercial-road,—"Loo-table."
4th,	1877.	William and Henry Hutchinson, Sheffield,—"Dilator for syringe."
5th,	1878.	M. P. P. Bourjeaurd, Davis-street, surgeon,—"Elastic pessary."
8th,	1879.	Edward Simons, Birmingham,—"Fastening for trouser-straps and other articles of dress."
10th,	1880.	Simon A. Kisch, Maddox-street,—"Auto-crumatic gown."
11th,	1881.	Richard Waygood, Newington-causeway,—"Corn and flour grinding and dressing mill."
—	1882.	John Davies Weymouth, Nailsea, Bristol,—"Terrestrial globe."
12th,	1883.	David Harcourt, Bristol-street, Birmingham,—"Egg blender."
14th,	1884.	John Bourne, Savage-gardens, London,—"Steamer."
15th,	1885.	William Bishop, Boston, Lincolnshire,—"Metallic box-end protector."
—	1886.	Henry Knight, Birmingham, engineer,—"Steam-engine indicator."
16th,	1887.	John James, John-street, Oxford-street,—"Railway travelling trunk."
—	1888.	Thomas Buckland, Islington,—"A cigarilla."
—	1889.	John Roberts, Eastcheap, London,—"Grape tile."

TO READERS AND CORRESPONDENTS.

W. R. K. London.—We do not see how any objection can be taken to the plan on the ground he mentions. The whistle is just as free for the legitimate use of the driver as before; and the fact of attaching a communicating cord for the guard cannot in any way inconvenience the driver.

THOMAS BELL, Southwark.—See any rudimentary work on the steam-engine. At page 240 of Messrs. Brown and Main's work on the Marine Engine, published by Mr. Hebert, 88 Cheapside, he will find the particulars clearly laid down and explained.

Mr. GOODMAN, Manchester.—The communication shall appear next month.

Mr. HALL.—Too late to be engraved for the present number; the drawing has been prepared for the next one.

QUESTION ON FRAME-WORK.—The number of communications on this subject, which we have received, has induced us to throw our remarks into the form of a short dissertation, bearing on the general principles involved. We shall give this next month, in place of any isolated notices which a reply to the original question alone would require.

JUVENIS, Aberdeen.—The Spanish windlass consists simply of a wooden roller, with a rope passed round it, through the bight of which a spike is inserted as a lever for heaving it round. It is a useful apparatus on board ships, where it answers well for setting up standing rigging. His other question will be best answered by reference to any standard book on Carpentry.

A BUILDER.—His polite letter deserves our thanks, as well for the spirit in which it is written, as for the hints it offers.

ON THE DIVISION OF LABOUR.

A judicious employment of the instruments of labour very materially increases their productive powers.

An excellent example and striking confirmation of this truth are seen in the effects resulting from the *division of labour*—a term employed, since Adam Smith's treatise, to designate that apportionment of occupations, by means of which an individual labourer is restricted to the repeated execution of the same operation, or at least of a small number of operations. According to the happy expression of M. Rossi, it is the great lever of modern industry, perceived, indeed, by a few persons in ancient times, but capable of being carried to perfection only by the aid of *capital*. Adam Smith, who first analysed the advantages of dividing labour, with a rare sagacity, ('Wealth of Nations,' b. i. ch. 1, 2, and 3,) ventured to say that the superiority of civilized nations over savages is entirely owing to this cause.

Let us notice the application of this principle to some special branch of industry—the making of playing-cards, for instance. The persons who make the paper are not the same as those who prepare the colours for printing the cards. In directing attention only to a single employment of these materials, we shall find that a pack of cards is the result of several operations, of which each one employs a distinct set of workmen, who are continually repeating the same operations. In short, each card is subjected to no less than seventy different processes, and if there is not a separate person to each of these processes, it is because the division of labour is not pushed to the extent of which it is capable, and the same person is charged with two, three, or four distinct operations. The influence of this separation of employments is very great. J. B. Say gives us the following calculation:—Thirty work-people would make in a day 15,500 cards, that is 500 cards for each person. Now a single workman, however skilful in his business, would not be able to make more than two cards in a day, or a 250th part, supposing him to go through all the different operations himself.

In the manufacture of pins, ten workmen, performing 18 operations, made in Smith's time 48,000 pins per diem, that is about 4,800 each, whilst, if one man had undertaken to draw out and straighten the wire, to cut and point it, to make the head, to whiten the pin, &c., he would hardly have made twenty pins in a day.

In drawing out steel wire for needles, in tempering, cutting, and pointing it, in making the head, and forming the eye, &c. &c., there are 120 operations. Now, it is not unusual to see establishments where they make 100,000 needles a-day for each man employed.

It has been calculated, that a pound of West Indian cotton, after it has been made into cloth in Lancashire, and returned to the West Indies for sale, has passed through 150 hands, and has been augmented in value 2000 per cent.

Such illustrations as these might be multiplied to any extent, but enough has been said to show the vast importance of the division-of-labour principle. Adam Smith attributes the prodigious power thus acquired to three causes:—1*st*, The workmen do not lose time by quitting one kind of occupation for another, by changing their places, positions, or implements; and the attention, always more or less slack, does not require arousing to make a fresh effort on being directed to fresh objects. 2*dly*, The mind and body acquire a wonderful skill in performing simple and often repeated operations. Let a common smith, who has been accustomed to handle the hammer, but not to make nails, be obliged to attempt the latter operation, and he will not be able to make above 200 or 300 in a day, and those very bad ones. A smith who has been accustomed to make nails, but whose sole or principal business has not been that of a nailer, could not make more than 800 or 1000 nails in a day; whilst boys under 20 years of age, who had never exercised any other trade than that of making nails, have been known to make 2300 nails in a day, and this without the assistance of machines, which have been invented for the manufacture of certain kinds of nails. In the manufacture of needles, children are employed to give them their eyes, by means of a punch. This operation they perform with great rapidity and address; and such is the skill of these juvenile workmen, that they will sometimes pass one hair through another with the view of attracting the generous notice of visitors. In time, the skill of those perpetually going through the same operation becomes prodigiously great: look at the performances of a piano-forte player, the rapidity of those who stitch the leaves of periodical publications, of a printing compositor, and of an accountant. 3*dly*, The division of labour leads to the discovery of contrivances for the abridgment of labour; it reduces each operation to a very simple and frequently repeated process. Now, this is the kind of labour which is most easily performed by implements or machinery. A part of the mechanical contrivances made use of in workshops where labour is most subdivided, were originally devised by common workmen, whose whole thoughts were bent on lightening the task which made up their only occupation. In the first steam-engines, a boy was employed to open and shut alternately the communication between the boiler and the cylinders. One of these boys, who had a strong love of play, observed, that by connecting with a string, the handle of the valve which opened this communication with another part of the machine, the valve would open and shut without his assistance, and leave him at liberty to enjoy himself with his comrades. And thus was invented one of the most ingenious devices of the steam-engine. It may be remarked also, that Wyatt, Lewis, Arkwright, Hargreaves, and Crompton, whose names are connected with improvements in the manufacture of cotton, were all of them originally common workmen.

It is by this division of labour that processes of every kind attain their greatest possible perfection. In dyeing, for instance—and in a place like Lyons, there are operatives famous for their blacks, others for their reds, &c., and who respectively devote themselves exclusively to dyeing blacks and reds.

Nor is it only in the department of manufactures, or in workshops, that we have cause to admire the adoption and effect of this principle. The sciences only attain a high degree of perfection when physicists apply themselves exclusively to particular branches. We have now-a-days astronomers, chemists, geologists, botanists, &c., and each branch of natural science can be again subdivided so as to afford full employment for the most diligent philosophers.

In commercial affairs, again, we find not only wholesale trading, retail dealing, the export trade, the East India trade, the West India trade, the China trade, &c., but even a separate trading in many varieties of merchandise. There are persons (bankers) whose business consists in receiving and paying money for others; and there are persons (brokers) who form a communication between sellers and buyers. By means of this subdivision, commodities are placed more conveniently and at a cheaper rate at the command of consumers. How happens it that we obtain clothes just of the kind we require, and at so low a price? It is because different persons make our hats, our coats, our linen, our stockings, and our shoes. What a number of different businesses are combined in the production of a coat: the sheep-farmer, the wool-cleaner, the cloth-manufacturer, the dyer, the tailor, the thread-maker, the button-maker, the makers of all the other trimmings, and of all the implements used in these different trades. How many years would it take a single person to make a coat by his unassisted fingers, even supposing that he had the ability to go satisfactorily through all the requisite operations?

Utility of the Division of Labour.—The preceding remarks will show what bad economy it would be to unite in one person several distinct employments, in order to reap the profits of each. No one can manufacture a commodity cheaper than he who employs himself exclusively upon it. A tailor can procure his hats cheaper by buying them of the hat manufacturer, than if he undertook to make them himself.

The same reasoning applies to many other cases, where the error is less apparent, though quite as real. It is chiefly the labour of commercial industry that is sought to be displayed. The business of commerce being in general only to convey products, to subdivide them, and store them up for the consumer's convenience, every trader, though not a merchant by profession, is ready to believe that he possesses the ability and the means of undertaking the business of a merchant with reference to some particular commodity. But if we enter into a careful calculation, we shall see that it is not an easy matter for such a person to derive the profits he supposes, from a transaction of this kind. 1. He is inexperienced, and we must all pay for learning a business we are ignorant of. 2. He is liable, not only to be deceived in the quality of the goods he trades in, but to lose upon the averages. 3. A commodity which does not altogether suit his particular purpose must be kept or sold, both perhaps at a loss, whilst a merchant has several modes of employing the goods that he purchases, and what he does not get rid of in one way, he does in another. 4. He will need a place for warehousing such articles as are not wanted for immediate use. 5. Loss of interest on the purchase-money of goods not used at once. 6. It is usual to consume a little more of such articles as are stored up in large quantities, than of those purchased only as they are wanted. 7. Extra expenses and risks are not taken into account. 8. And lastly, the time taken up in this transaction might have been better employed in attending to one's own peculiar department. When the whole thing is completed, we may ask what has been saved? In most cases, we have kept from the merchant a profit which would have been nothing more than a fair remuneration for his labour—labour which it has been necessary for us to bestow, and which has, in fact, cost us a larger sum. The care and attention bestowed upon our own peculiar business are generally the best recompensed, because we have there the full benefit of experience, and our efforts are there best regulated and directed. When we are running after every species of profit, we are in danger of losing them all.

In fine, to divide labour is to abridge and simplify labour, and consequently to save time and expense.

Of the Division of Labour amongst different Nations.—The different countries of the globe do not all produce the same things. France applies herself to the cultivation of the vine, Russia to hemp and tar, Poland to grain, Spain to wool; and if it is better for a shoemaker to buy his furniture from his neighbour the cabinet-maker, and for the latter to purchase his clothes from his neighbour the tailor, so Russia ought not to attempt the cultivation of the vine on her steppes, nor France to grow pine-trees amongst her vines. For these two nations to act thus, would be to act counter to their true interests. Common sense dictates that exchange is the best mode of counterbalancing the natural difference of their climates.

The question, however, is not always so simple, and natural productions do not often discriminate countries so completely as these. In some cases, indeed, different countries claim the same production as an indigenous one. For instance, iron is worked on an extensive scale in England, Belgium, France, and Germany. Coal, again, is found in England France, and Belgium. We should smile, doubtless, at seeing persons endeavouring to produce a good wine in Siberia; but we should not be surprised to see them manufacturing iron in France, if they could dispense with the protection of duties, which impose loss upon consumers, and throw the trade into an artificial channel.

Differences of soil and climate are not the only causes which bring about a diversity in manufacturing industry; the history, the laws, and the manners of a people, equally modify their labours. We may remark that, in Europe at this day, either by chance or by special circumstances, most nations have become celebrated for their excellence in particular manufactures, though the same branches of industry are, to some extent, carried on by the rest. Indeed, most branches of industry are sought to be naturalized amongst the people of every country. A series of complex phenomena flows from this tendency, with which statesmen are wont to deal, submitting to prejudices which shelter themselves behind sophisms, and without sufficiently considering the economic effects which result from such proceedings. But this is not the place for grappling with a practical question, of which the elements are as varied as the branches of industry to which it may be applied. We will only state that the natural division of labour amongst nations has been thwarted, down to the present day, by mercantile theories, and protectionist doctrines. Nations will only find their true industrial position, when their natural interests are left to develope themselves freely.

Origin of the Division of Labour, and its Limits.—The division of labour, from which so many advantages accrue, is not the result of human foresight; it proceeds from natural causes, which it is easy to trace.

The most industrious of animals only labours for what it can consume, or for what its progeny consumes. Man makes much more than will satisfy his wants, and exchanges the surplus for other objects which civilization renders necessary to him. The interest of each individual prescribes to him the choice of a single occupation, and the prudence of adhering to it in order to produce the greatest possible number of exchangeable objects. Thus barter is the primary cause of the division of labour. Now, the power of exchanging can only take place when the rights of property are established. The existence of the Moravian brothers, and of certain co-operative societies, where the occupations are separate and the productions common, form no objection to this assertion: *firstly*, Because they exist in places where their property is secured to them by law; *secondly*, Because they admit a certain mutual exchange of the labours of their members; and, *lastly*, Because it has not been proved that this mode of association can extend itself, and be perpetuated in the absence of the stimulus which springs from the right of each individual to possess, and exclusively to enjoy, that which his personal exertions have produced.

Since the division of labour is founded upon the possibility of an exchange, we may conclude that it is necessarily limited by the extent of the *market*. By this word is understood, in political economy, every town, every country, which affords a demand, an outlet, for manufactured commodities. Thus Europe has become a market for the teas of China, the sugars of the West Indies, and the cotton of America. The reason that 30 workmen are employed, under a well-regulated division of labour, to make 15,500 cards in a day is, that the manufacturer can find a market for this number; for if he were only able to dispose of 5000, he would not employ so many workmen, and consequently each workman would be charged with more distinct operations. In a small town where the demand for commodities is languid, or the market inconsiderable, many labours of different natures are performed by the same pair of hands. For instance, the same individual is physician, surgeon, and apothecary; whilst, in a large city, the business of a surgeon is divided into several branches, and it is only in such a place that we find dentists, oculists, and chiropodists, who are more skilful than they would otherwise be from this very circumstance. It is also in cities that the arts acquire their perfect development, afterwards to spread over the whole surface of a country.

Commercial industry suggests similar observations. Take the case of a village grocer; the limited consumption of the place obliges him to combine the businesses of druggist, cheesemonger, chandler, stationer, &c., whilst in London, Amsterdam, and Paris, there are shops confined to the sale of teas, oils, cheeses, &c. It follows that the vendors of these commodities are better acquainted with each, their different qualities, the uses to which they can be applied, and the various countries whence they are obtained; and, in short, that their shops are the best.

There is less division of labour in the finer productions. A smaller quantity is made, and, in consequence of their high price, there are few purchasers. In fine jewellery, the division is trifling; and as we have seen that this division is one of the causes of the discovery, and the application of the most ingenious processes, it is precisely in the productions of fine workmanship that such processes are least seldom met with.

It has been stated, that the division of labour takes place in direct ratio to the means of disposing of the commodities produced. We may add, that these means are in direct ratio to the facility of conveyance. In fact, the division of labour can advance little when the conveyance of its productions is difficult or expensive (these are synonymous expressions). Now, if the division of labour in any branch of industry is little advanced, that branch of industry is frequently backward. The manufacture of earthenware in France is in this state. The earthenware is thick and clumsy, and every locality is obliged to have its own manufacture, wherever the new means of communication have not corrected this fault.

Hence it follows, that maritime countries are most favourable to the division of labour; for a conveyance by sea is the least expensive of any. It is also to be remarked, that those countries which are most advantageously situated on the sea were not only the first to embark in commercial undertakings, but the first to cultivate with success the other arts of industry. Thus the earliest examples, on a large scale, of industry and civilization, are to be found amongst the nations who formerly inhabited the sea-board of the Mediterranean.

The discovery of the compass wonderfully facilitated the division of labour, by assisting a great number of countries to perfect their navigation and widen their market, especially when their interiors were connected by canals with rivers and the sea-coast. Steam power has been attended by similar results.

The division-of-labour principle seems eminently compatible with manufacturing works in general, on account of the very nature of such works, and because the greater part of the productions are easily conveyed to other places. Agriculture least admits a division of labour, on account of the variety of operations to which the soil must be successively subjected, and the change of the seasons. We cannot sow or reap all the year, and thus a large farm employs fewer workmen than a small manufactory of pins. Except at hay-time and harvest, there are hardly ten workmen who work in the fields when it is fine, under cover when it rains, and all of whom are busied with many different occupations. In agriculture on a large scale, carried on with a large capital, and requiring a great number of labourers, the principle can of course be more readily applied.

The application of the principle is limited by the extent of capital; for, in order that the division of employments should be carried out, a great number of workmen is necessary, and that requires a spacious edifice, a large supply of materials, much machinery—in short, a large capital. We must except the case where materials to be wrought up are of little value, and the tools of small cost, and especially if the operations are distributed amongst various trades. For instance, there is great division of labour in the preparation of a pair of gloves; the cattle-breeder, the butcher, the tanner, the currier, the cutter, the sewer—these are not the same persons, and each of them exercises his business with a limited capital. We may remark, that an attempt to unite these different operations would probably not be warranted by any saving of expense.

Of the Inconveniences alleged against the Division of Labour.—Several persons have spoken of the effect upon the labourers of the application of this principle, and many remarks have been thrown out, which deserve consideration.

First Objection.—With the division of labour, a man is nothing more during his whole life than a machine—a lever, a screw, or a pivot. The savage contending with the elements for his life, and subsisting upon the produce of his fishing and hunting, is at least a compound of strength, cunning, ingenuity, and imagination. The labourer, whom the variety of the seasons, of soils, and of cultivation, drives to the use of incessant combinations, remains a thinking being; but the workman, who has done nothing but lift the sucker of a pump, or make the twentieth part of a pin, loses the use of his intellect and his moral sense; his intellect, because he is only acquainted with the twentieth part of a small thing—his moral sense, because he has no opportunity for reflecting on his duties, nor of elevating his thoughts to God.

It is not to be denied that there will be a degeneration in the faculties of a person, when the *whole* of his occupation, attention, care, and time are confined to an operation of detail incessantly repeated. It would, however, be wrong to suppose, that an operation of this kind necessarily brings on a brutalising debasement, if the workman has any leisure, and suitable wages. A man may be a stonecutter, and yet have time to devote to his wife, his children, his friends, his pleasures—in a word, when the intellectual part of his being receives nourishment; and even during his labour, the more simple his work, the more opportunity has his mind of turning to other things. We must not confound the effects of excessive toil and of inadequate wages, which are the consequences of an excess in population, with the effects of the division of labour. These are two questions perfectly distinct.

We may add, that those who, in the arts, devote themselves to the most mechanical operations, are not in general persons of the best order of mind. He who has the stuff to make a good sculptor, will not continue a stonecutter. It may also be observed, that all productive labours are, by reason of their repetition, in some degree mechanical. Making arithmetical calculations, resolving equations, correcting proof-sheets or faults in grammar, compounding medicines, &c., these have something in them analogous to the polishing of hard bodies, or to any other employment considered of an inferior rank. On the other hand, when an intelligent labourer concentrates his attention upon an operation, this operation, however simple it may be, is found capable of division. The field being less vast, the scrutiny is closer, and this is the scrutiny that leads to discoveries. Some one inquired of Newton how he came to discover the principle of attraction? By always thinking about it, he replied.

There is no proof whatever, that the division of labour leads to moral depravity. We do not find in the country, where the division is less minute, that the agricultural labourer has a moral or intellectual superiority over the artisan, other causes of demoralization being kept out of view. Does the savage afford any support to the argument? On the contrary, since industry has been expanding in Europe, we have seen the division of labour and the intelligence of the lower classes of society increase with a parallel movement.

Second Objection.—As labour becomes reduced to operations of extreme simplicity, the workman is liable to be supplanted by the first comer. Besides, he cannot easily reinstate himself in a similar employment elsewhere; he remains in an absolute and discouraging dependence upon his master, who lowers his wages as he pleases, and all opposition is useless.

An answer to this objection is to be found in an exposition of the true principle of population. It is always necessary that the number of men be proportioned to the disposable labour. However skilful the operative may be, it is seldom that he cannot be supplanted by some one else, and this is not an inconvenience special to simple operations. In the case, indeed, of men having a peculiar kind of talent, there can of course be no competition, and these persons possess a real monopoly.

It may be observed, that, to a certain extent, the division of labour binds the lot of the workman to that of the manufacturer, and renders his position more secure. For a stoppage of his manufactory is injurious to the manufacturer in a high degree, and it is only at the last extremity that he will consent to a suspension of his works; whilst the workman who has his own tools and works at home, is more easily dispensed with. At least this holds good, as long as the operatives attached to a manufactory do not, by competition, ruin each other's market for their labour.

The division of labour has a tendency to transform individual labour into associated labour; and the law discovered by Adam Smith, which has made industry advance so rapidly, will continue to have an immense influence through all future time.

In considering this question, we must not confound the effect of the severance of operations with the results of machinery. Machinery renders superfluous the employment of many hands, but does not simplify the labour of those who continue to have employment.

FLOATING RAILWAY ACROSS THE TAY, ON THE LINE OF THE EDINBURGH AND NORTHERN RAILWAY.

(*Illustrated by Plates* 30, 31, *and* 32.)

SECOND NOTICE.

The two plates accompanying this article, furnish the remaining details of these extensive works. Plate 31 presents, in fig. 1, a longitudinal section through the harbour at Ferry-Port-on-Craig, on a scale corresponding to that of the similar view of Broughty harbour in plate 30. This section also shows the steamer in her position for embarking or disembarking waggons, together with the house containing the stationary engine used for this purpose. Fig. 2 is a corresponding plan of this harbour, showing the high and low water landings, quays for the loading of vessels with coals or produce, the cattle loading bank, station-house and platforms for the passengers, with the rails laid round the wharfage.

In plate 32, fig. 1, is a longitudinal section of a portion of the same harbour on a larger scale, showing more in detail the steamer, stage, float, and machinery. This view is broken off just at the point of the upper joint of the stage, and the remaining portion, including the engine-house and chain gearing, is represented in fig. 2. Fig. 3 is a corresponding plan. The stationary engine for the chain gearing is of the horizontal direct-action kind; the crank-shaft carries a pinion set alongside the fly-wheel, and gearing with a spur-wheel on the pulley-shaft. Three sets of endless chains are used—one for each of the three lines of rails. From the driving pulleys on the crank-shaft of the engine, the chains pass round subsidiary tension pulleys placed at a short distance in front; thence they pass over sheaves carried by the stage, and turn round a set of pulleys at the float, passing up on sheaves beneath the stage, to the driving pulleys at the top. These details are clearly shown in the larger views of plate 32, which also gives a better explanation of the steamer—the specification of which we here append.

Length of deck, 170 feet; breadth between paddles, 34 feet; depth of hold from bottom to underside of deck at centre of vessel, 10 feet. The keel is formed of plates 16 inches broad, by ¾ inch thick. Stems are of malleable iron, 6 inches × 2½. Frames of angle-iron, 5 inches × 3½, spaced to 18 inches throughout. Reverse frames from gunwale to gunwale, 3 in. × 3 in. × ⅜. Floors on every frame from 18 inches to 24 inches deep × ½ inch thick. Plates from keel to 2 feet water line, ½ inch thick for about 100 feet amidships; remainder ⅜ inch; from 2 feet water-line to gunwale, ⅜ inch. Bottom to 2 feet water-line, double riveted. Box kelson, running the whole length of the vessel, 18 inches square, framed with ⅜ inch plates. Stringers of 18 inches broad, ⅜ inch thick, and 4 in. × 4 in. × ½ inch angle-iron. Beams on every alternate frame, 12 inches deep × ½ inch thick, with T iron on upper edge, fastened to frames with knees of the same thickness, and supported by iron stanchions 2 inches diameter, where required.

Bulk-heads, one before and one abaft engines and boiler, formed of ⅜ inch plates; and one before and one abaft these two, of the same strength. Wings, 12 inches deep, framed with angle-iron 4 × 4 × ½ inch, covered with plates 12 inches broad × ½ inch thick, with a plate on top and bottom 12 inches × ¼ inch thick. In the actual construction of the vessel, this was not executed in this manner—oak 12 inches × 16 inches being substituted. Carlings, 2 feet apart, same depth as wings, with T iron on top and bottom.

Wingwales of ⅜ inch plates, having a belt of elm timber, 9 inches broad × 5 inches thick, running fore and aft the whole length of the wing. Decks of yellow pine, 3 inches thick, fastened to beams with ½ inch screws, and a stout hardwood plank, 8 inches deep, bolted down through the beams, for carrying the rails for the trucks. Rails are 45 lbs. to the yard of the single T section, with a flat bottom rib. Waterways and covering boards of red pine, 4 inches thick × 18 inches broad. Stanchions of African oak, 4¼ inches thick × 5 inches broad. Rails of elm, 2½ inches × 9 inches. Bulwarks of yellow pine, 1 inch thick. Paddle-box stanchions of Dantzic oak, 4½ inches square.

The interior of the vessel is fitted up neatly for first and second class passengers, each end having two cabins, one for gentlemen and another for ladies.

As the first experiment of the kind, the trial of this arrangement is to be looked forward to with considerable interest. The steamer, now lying in the Clyde, is to be tried first on the Frith of Forth, between Granton and Burntisland. This test will show at once the practicability or otherwise of the scheme, as the distance is about 5 miles—and the sea is sometimes rough. Should the plan answer here, the vessel will either be taken round to the Tay, or a second one will be procured for that river, leaving this to ply permanently on the Forth.

ON THE CONSTRUCTION OF LOCOMOTIVE ENGINES.

A question of great importance in railway economics has arisen since the introduction of Mr. Samuel's light express engine, and others of the same class—namely, that of the relative advantages of light, *versus* heavy engines.

The locomotives now generally used are of a very heavy class, requiring, at the higher speeds, a proportionably heavy permanent way, and expensive substructures. Following up the history of these engines, we find, that from the first in use in the infancy of the Liverpool and Manchester railway, the size and weight have been gradually increased, to meet the growing requirements as to the velocity and the loads to be taken. From about 6 tons they have advanced to about 25 tons (narrow guage engines), and from a speed of 12 miles to 40 miles per hour.

On the main trunk lines, these powerful engines are constantly necessary, the traffic being both considerable and very regular; but on many smaller or branch lines, the traffic fluctuates to a great extent, and the vast amount of motive power necessary on the large lines is only occasionally required, whilst the velocity is the same. For such lines the above light engines have been proposed for the conveyance of passengers. It may be doubted whether they will ever answer for goods traffic. Even on the most insignificant railways, times will occur, such as fairs, markets, &c., when the traffic will be unusually great; how will such carriage engines answer then? Are heavy engines to be kept and maintained for such extraordinary occasions? Another great disadvantage attending this new system is this—engines are more subject to injury than carriages, and are therefore oftener under repair; the consequence is, whenever the engine must be temporarily taken out of employment, the carriage, without requiring it, goes with it, and a greater number of them must be constantly maintained than the usual traffic demands.

It is not, however, the intention of this paper to inquire into the merits or demerits of this new system, but to point to some improvement in the common engine, increasing the duty performed, or rather decreasing the proportion of unprofitable weight in relation to the paying weight, which improvements are, while the present high speeds are retained, to counteract some of the causes of the wear and tear, which swell the working expenses to so enormous an extent. It will be shown that the aiming at high speeds with the common engine is attended with a great loss of power, the consequence of which is the very low ratio between the weight of the engine (unprofitable weight), and the load transported (the paying weight).

The following comparison between the duties of two engines, of very different constructions, will clearly show this loss attending great speed:

In a former part of this journal (pp. 59 and 60), an account is given of some experiments with engines of the latest construction (1848), furnished with all the improvements which twenty years' experience in locomotive building has supplied.

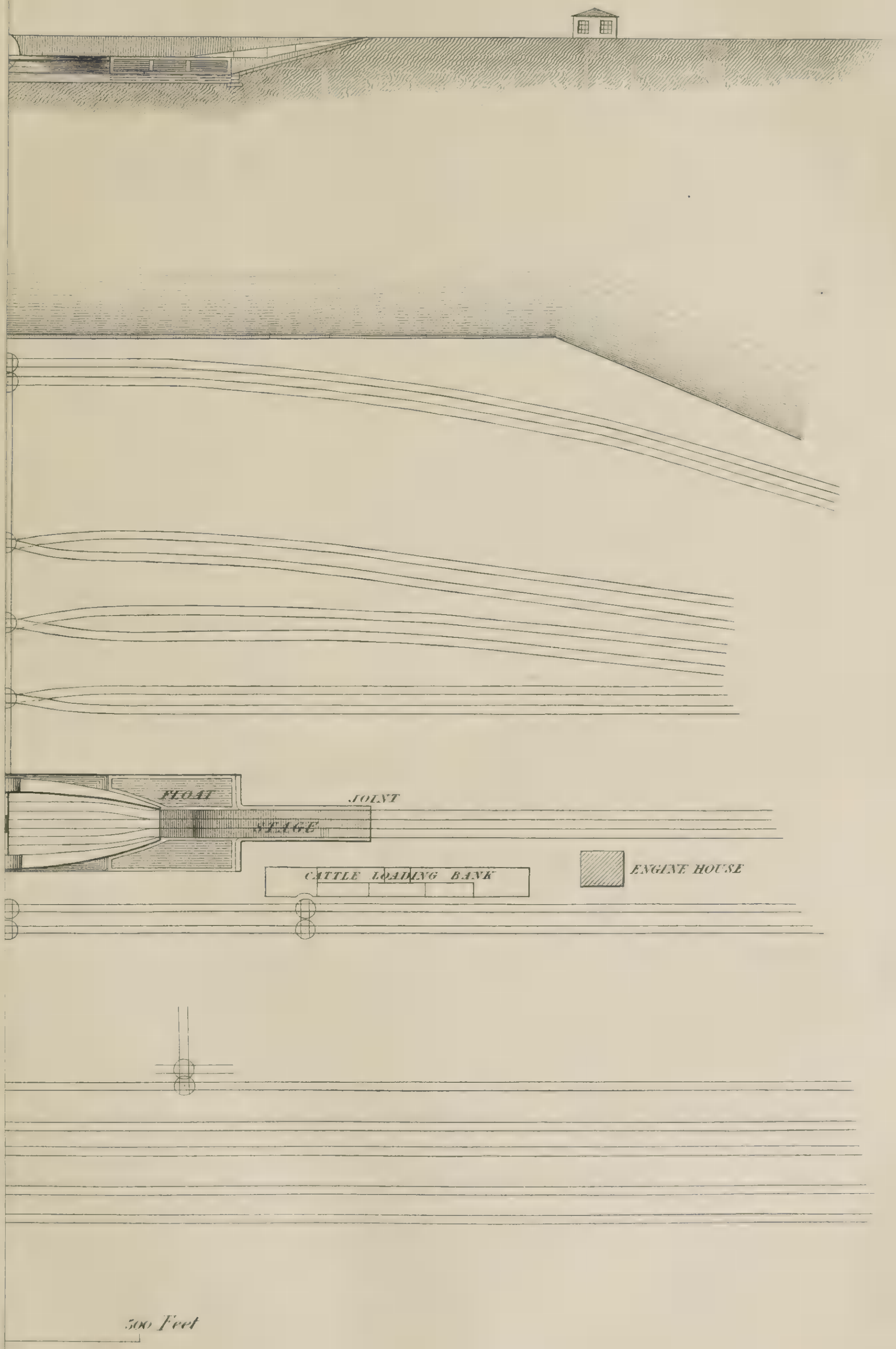
In the first trial there stated, an engine, built by Messrs. Sharp, Brothers, and Co., with 16-inch cylinders, 20-inch stroke, and 5½-feet driving wheels, took a load of 64 tons, exclusive of engine and tender, or a gross load of 98, say 100 tons, at an average speed of about 49 miles per hour. The engine, as there stated, weighed in working condition about 21½ tons, the profitable load carried is therefore three times the weight of the engine. Pressure of steam not stated.

The following is an extract from the daily register of the duties of engines upon a railway where engines of the American construction were used, and is the account of one trip, the engine being driven by myself.

The engine weighed, in working order, 14 tons, 12½-inch cylinders, 20-inch stroke, 4½ feet driving wheels. The gross load was 118 tons; the profitable load 99 tons, or seven times the weight of the engine. The average speed, upon a length of nearly 50 miles, including the loss of time in slackening speed on approaching, and in getting up speed in starting from four intermediate stopping places, was 18 miles an hour. Pressure of steam 80 lbs.

In the first report of Messrs. Sharp's engines, there was no loss from so frequently slackening speed and stopping, which is in favour of that trial. The line was also favourably chosen, being partly a gentle and regular gradient of $\frac{1}{330}$, with the same descent; while the second stated trip was made on a line containing a number of very sharp curves, and various gradients, the steepest, which is also placed in the sharpest curve, being $\frac{1}{114}$.

Plate Vol. II.



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RAILWAY FERRY.

FERRY-PORT-ON-CRAIG HARBOUR.

Fig. 1.

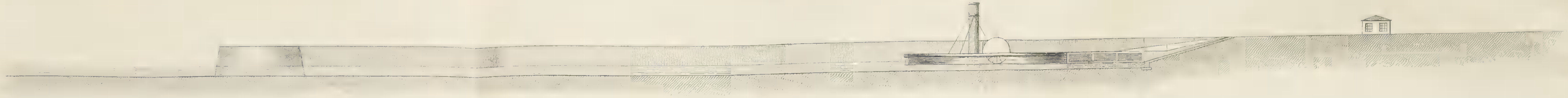
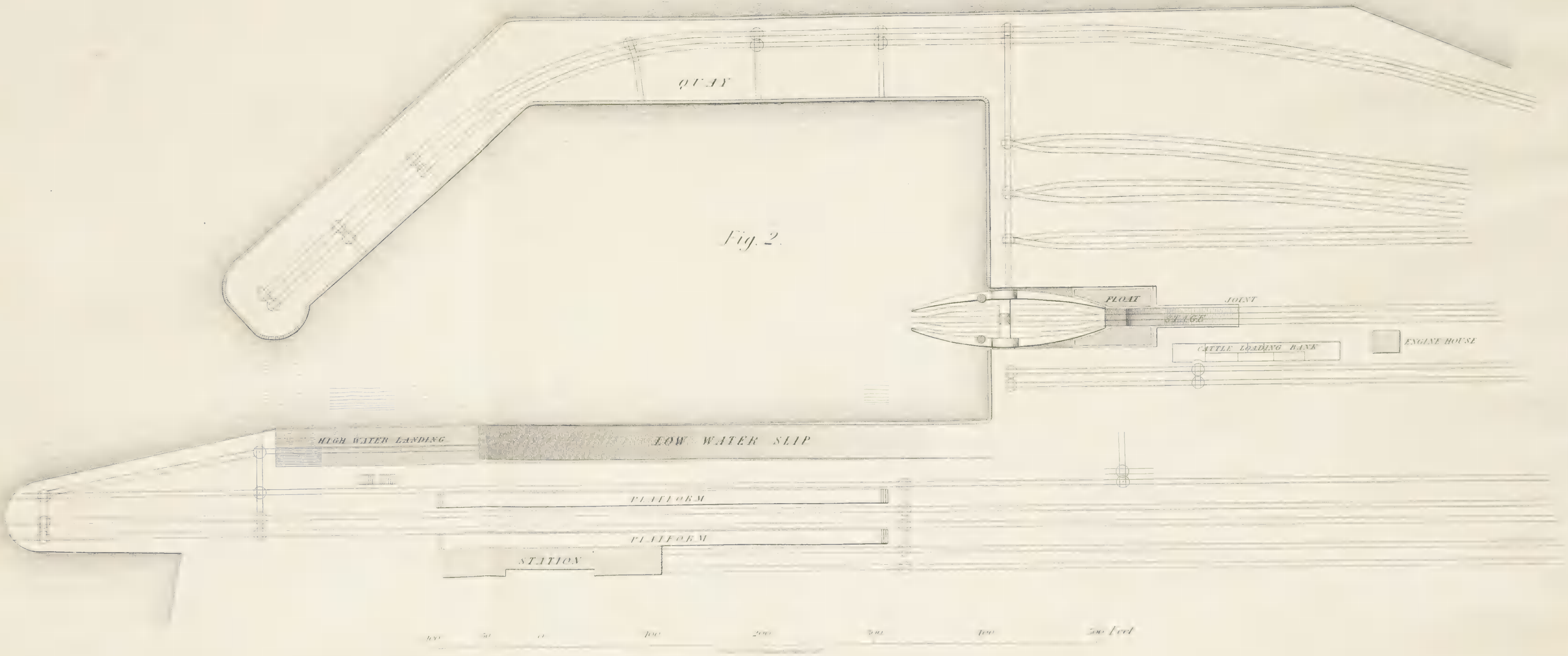


Fig. 2.



W. Johnson
Patent Office, Glasgow

Geo. Aikman sc. Edinr

RAILWAY FERRY.

STEAMER, FLOAT & SLIP.

Fig. 1.

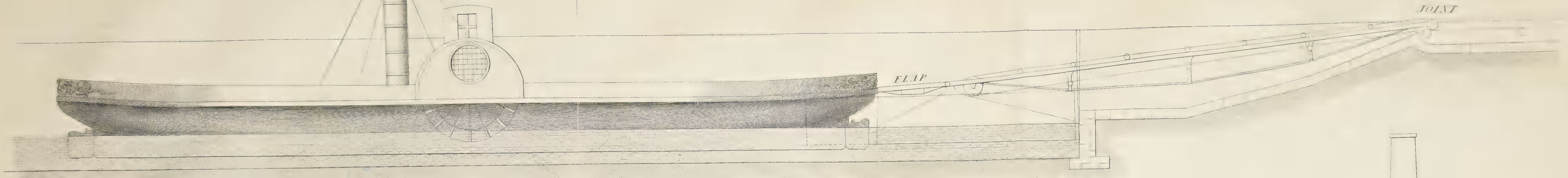


Fig. 2.

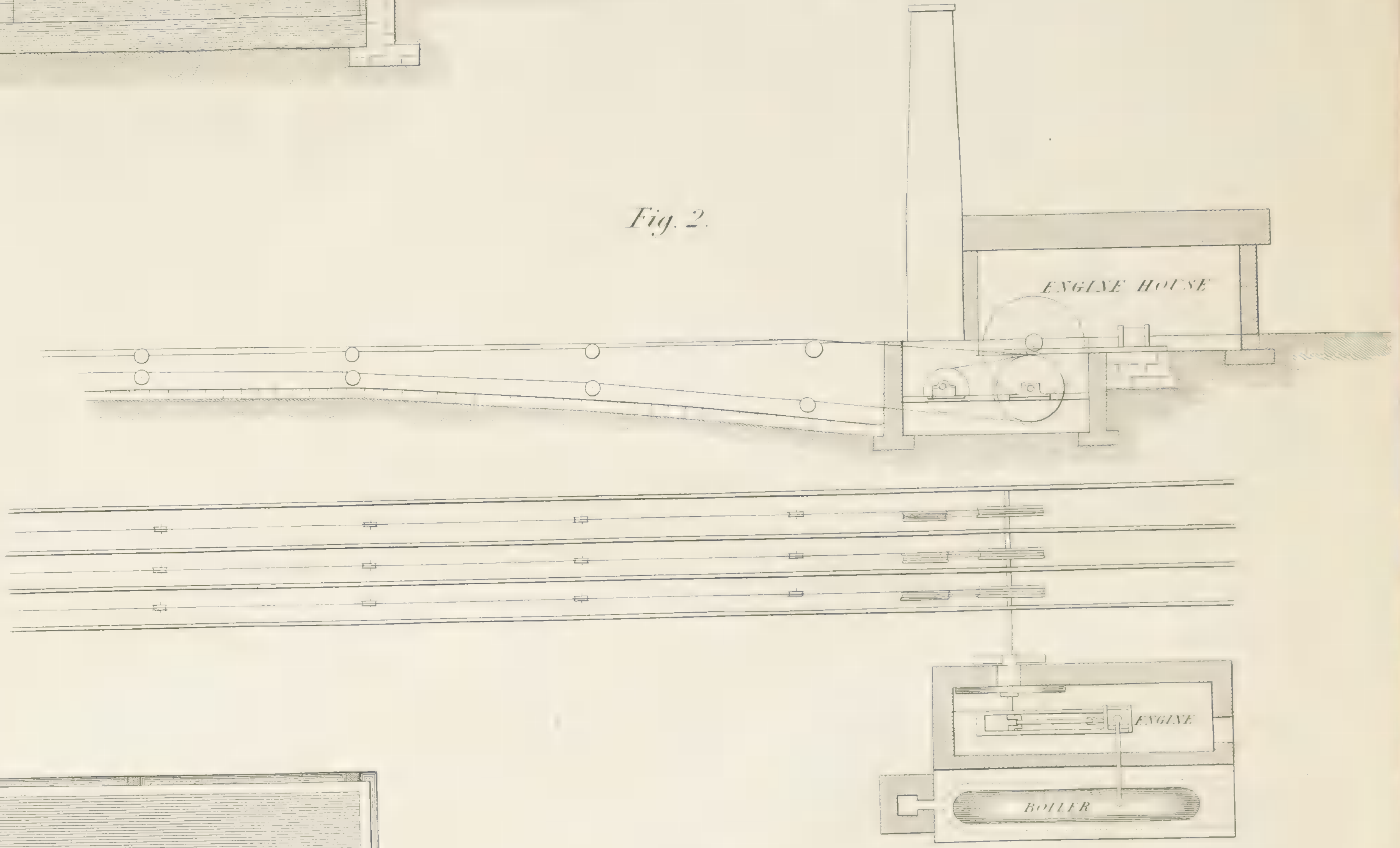
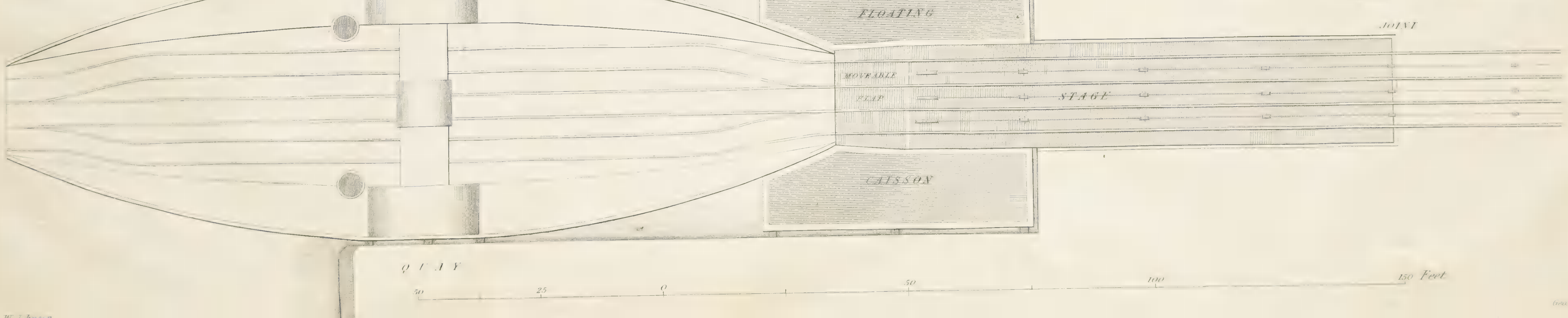


Fig. 3.



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In the pressure of steam there would probably not be much resistance, 80 lbs., I believe, being generally used.

Taking, therefore, the area of the piston as a measure of the power expended, pressure and stroke being the same, the two engines would have a relation of 201·0 : 122·7, the paying load transported, in terms of their own weight, being as 3 : 7, and the speeds as 49 : 18.

The power given out by the boiler, and expended by the cylinders, equals the number of cylinders full of steam used. The relation of these powers in the same time by the above engine is as 3·9 : 1; for in one hour, at 49 miles, the first engine would require, taking no notice of slippings, 59,898 cylinders full; the second at 18 miles, 27,288, which, multiplied by the relation between the area of pistons, 201 : 122·7, will give the above ratio of expended power of 3·9 : 1; now, the loads transported, bear the ratio of 64 : 99, the speeds attained, 2·73 : 1. The duties of the two engines, in reference merely to the paying weight, are, therefore, as 64 × 2·73 : 99 × 1 = 1·75 : 1, while the power employed was as 3·9 : 1.

How was the remaining power absorbed? One particle of this power is spent in the propelling of the tender, which, in the above investigation, has been omitted. Locomotives must be provided with tenders, or a substitute; but the size and weight of the appendages may be very much varied. Thus, in the first example, the tender weighed 12½ tons; in the second, only 5 tons. The one tender carried water sufficient for a trip of 40 miles; the other only for about 15 miles. The policy of very large tenders, so far as economy of working is concerned, may be questioned. Certainly, with smaller tenders, the express trains might be obliged to stop at one or two places, which they now pass by, for the purpose of replenishing their stock of water; but the public at large would be no losers by this arrangement. The speed of the engine would not be materially decreased, while power would be saved to meet this decrease, and one carriage with passengers might be carried more than at present.

In the new outside cylinder tank engine, made by Messrs. Sharp, Brothers, and Co., for the North Western Railway, the power generally absorbed by the tender is almost entirely saved for traffic purposes. Here the tender is done away with; a tank is placed underneath the barrel of the boiler for the supply of water, and the fuel on an extension of the foot-board. There is a saving of about 7 tons weight upon the ordinary weight of an engine and tender of the same power—the weight of a goods waggon loaded—with this further advantage, that an alteration takes place in the position of the centre of gravity of the engine, which tends to secure a more steady motion.

The chief cause, however, of the enormous loss of power at high velocities, is to be sought for in certain resistances, which increase in a greater ratio than the speeds.

Atmospheric resistance will not be considered here. No improvement in the construction of locomotives will lessen that; and an investigation of its amount does not lie within the scope of this paper. Atmospheric resistance we cannot remove; but the resistances from friction and oscillation absorb a vast amount of power; and this may be decreased, to the increase of the effective power, and the lessening of working expenses.

The tractive power of an engine depends on the weight resting on the driving-wheels. The hind wheels of the small engine were its driving-wheels; they were placed in front of the fire-box. The insistent weight is rather more than two-thirds of the whole weight of the engine, a much larger proportion than in the common six wheeled engine. That is one advantage; and will enable the small engine to propel a load, bearing a larger proportion to its own weight, than the large engine.

Another advantage consists in the low position of the centre of gravity; which, in all outside cylinder engines, may be placed lower than with inside cylinders. No one will dispute, that the lower the centre of gravity is, the more steady must be the motion. A more steady motion reduces the straining among the different working parts, and diminishes the wear and tear; thereby saves power, and renders the engine more durable. What causes the wear and tear in locomotion? Not the velocity alone.

It is well known, that engines at very high speeds, assume a sort of jumping motion, instead of a simple rolling one, owing to the combined action of the pistons, and the inequalities of the surface of the rails. This inequality is unavoidable. Sometimes the rail on one side has sunk, sometimes that on the other. Between the sleepers, the rail is more elastic than the part lying on the sleepers. At every joint of the rails there is an irregularity, which gives a shock to the driving-wheels, and thence to the crank-axle, connecting rods and eccentrics, which shock is not communicated to the cylinders, pistons, &c., because they are fastened to the frame; and this receives only so much of the shock, as is not taken in by the springs. The different parts of the machinery are intimately connected together; upon their nice adjustment and good fitting into one another, depends the efficiency and easy motion of the machine. Placed on a railway, one part of the machinery remains comparatively immoveable, whilst another is exposed to a constant uninterrupted series of shocks. But this is not all, for it produces straining in a vertical direction. Curves cause an immense side-straining; they twist the working gear. To allow for this, and prevent sudden fracture, considerable play is given sideways in the journals in the first construction of the engines. The force of these strains is so great, that, without this play, an engine might, in some situations, be brought to a full stop, the whole of its power being scarcely sufficient to overcome the great amount of this resistance.

The causes for this straining cannot be done away with. A perfect line of railway cannot be made; and, if it could, it could not be maintained. A form of engine must be aimed at, which will reduce these disastrous effects. Before such a form or mode of construction is obtained, only a small part of the power expended can be made available for profitable purposes.

Two alterations are obvious—one in the position of the boiler, another in that of the driving wheels. The boiler must be considerably lowered. High speeds can only be attained by means of large driving wheels. The usual construction of engines is incompatible with a low boiler; therefore, the driving wheels must be removed from their present situations and placed behind the fire-box.

Having the driving wheels or crank-axle in the centre of the engine, between the other two pairs, it acts as the fulcrum of a lever. When the inequality of the rails causes the front wheels to descend into a hollow—which, even in a perfectly constructed railway, would always occur when they descend from a sleeper, owing to the elasticity of the metal—the engine sinks down with the front axle, and the hind wheels are released from all weight. When the fore wheels are on the ascent, the driving wheels are relieved of part of their weight, which is thrown on the hind wheels. When the driving wheels are placed behind, with the trailing wheels in the middle, carrying but little weight proportionally, such an action is avoided; at the same time, nearly the whole weight resting on the extremities, the oscillation in the direction of the engine's length is obviated. The action will be still more improved by placing the weight of the cylinders behind the front wheels, instead of allowing them to overhang, as is now the case. The consequence of a great overhanging weight may be noticed in many of Stephenson's long boiler engines, which have an overhanging fire-box. In many old engines of this description the fire-box may be observed to lean downwards, as if, that end not being supported, its weight had caused such a strain as to overcome the original strength of the frame, and forced it to give way.

The alterations now mentioned are exemplified in Mr. Crampton's patent locomotive. Inside cylinders will not do for this form of construction. A third alteration is still wanting to render the engine tolerably complete. The disadvantage of the numerous and irregular jerks continually received by the crank-axle, through the driving wheels, has been already hinted at. The axle, connecting, and eccentric rods receive these shocks in their full force. The cylinders, pistons, steam-valves, slide-rods, guide-bars, and valve-gearing are fixed solidly to the frame, and receive these shocks but very slightly, they being mostly neutralized by the action of the springs. The crank-axle, with its parts, is lifted up and down with the wheels; sometimes both ends equally, sometimes one side falls, while the other is raised up; whereas the remaining parts are not changed in their actual position. Could the connecting and eccentric rods be made of infinite length, the angle caused by this change of relative position would be exceedingly small. But the advantage and safety of constructing rods of an undue length, that move at the rate of about 1200 feet per minute, is doubtful.

If we could attach the crank-shaft to the frame, in the same solid manner as the cylinders, then all parts of the machinery would be always equally affected, and one cause of friction, straining, wear and tear, and undue loss of power would be removed.

The conclusion arrived at is, that a separate crank-shaft must be introduced, and the driving wheels worked from this by outside cranks and side-rods. The eccentrics may be conveniently worked by a returning crank-arm, fitted on the crank-pin of the outside crank, thus avoiding the friction of eccentric rings.

The reaction of the hopping motion of the driving wheels is thus intercepted and destroyed before it can injure or produce a strain among the parts of the machinery, which will much more than compensate for the additional friction of the intermediate shaft.

The driving-wheels being placed behind, their diameters may be increased, so that, whilst the speed of the engine is retained, the velocity of the piston is diminished. Less steam will be consumed, and therefore a greater economy of fuel will ensue. But the great advantage is in the reduction of friction and oscillation, and a consequent saving of power, with greater durability of the machinery; and at the same time the tractive power is increased, for a larger proportion of the whole may be thrown on the driving wheels.

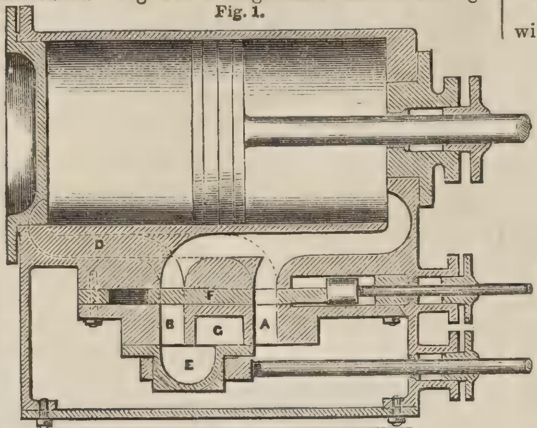
In a future number I shall return to this subject, for a few more remarks on the other parts of the locomotive.

Bradford June 9, 1849. T. Passavant.

REVERSING APPARATUS FOR LOCOMOTIVE ENGINES.

During the past month we have received two schemes connected with the reversing and working mechanism of the cylinders of locomotive engines, both of which possess some features of ingenuity, and may furnish hints for constructive adaptation. The first, illustrated in figs. 1, 2, and 3, is by Mr. R. Elsdon of Lemington, near Newcastle, and has for its object the reduction of the moving gearing, by doing away with one set of eccentrics and connections, together with the usual reversing link, or other similar contrivance. Fig. 1 is a longitudinal section through the valve-chest, steam-ports, and cylinder; fig. 2 is a plan of what the inventor calls a mouth-piece, which is screwed to the cylinder-face; or, what is the same thing, a plan of the cylinder-face, upon which the reversing valve slides—the dotted lines representing a plan of the steam-channels to each end of the cylinder; and fig. 3 is a plan of the supplemental valve placed beneath it for the purpose of reversing. In place of the two ports, as usually provided for the admission of steam to the top and bottom of the cylinder, it is proposed to use four. In fig. 2, the ports, A B, communicate with the upper end of the cylinder, and those marked C D with the lower end. The section, fig. 1, shows how this is accomplished. As the valves are now set, the piston being at the middle of the cylinder, steam is entering at the top to force it down, as the steam-slide, E, has uncovered the two ports, A and C; but as the adjustable slide, F, detailed in fig. 3, is interposed between the cylinder-face and the mouth-piece, C, fig. 2, the steam really finds access only by the port, A. This results from the arrangement of the thoroughfares in the reversing-slide, F; for, under the conditions we have named, its port, B, corresponds with that similarly marked in the mouth-piece, and the same correspondence exists between the two ports marked C. In the way it is now set, then, the port, A, in the mouth-piece, G, is opposite to the corresponding port in the slide, F; and similarly, the opposite port, D, leading to the contrary end of the cylinder, is in direct communication with that in the slide, F, which bears the same letter of reference; and the remaining ports, B and C, are virtually closed, as they are opposite blank portions of the slide, F. Thus, so far as the valvular action is concerned, the steam is admitted to, and leaves the cylinder, just as in the ordinary slide-valve, where it works directly on the face of the cylinder. The steam passes in by the uncovered port, A, to one end, and the exhaust leaves the other by the one marked D, covered by the hollow of the steam-slide. When it is intended to reverse, the slide, F, is pushed inwards by its rod, which passes out through a stuffing-box in the front of the valve-chest, until the steam passages are entirely reversed by the ports, B and C, in this slide, being brought to correspond with those in the mouth-piece and cylinder-face, whilst A and D are closed by the interposition of the blank part of the valve, F. Thus, the motion of the engine is at once reversed without the employment of any backward eccentric, or reversing link, or additional movement of any kind.

Fig. 1.



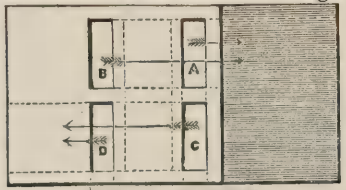


Fig. 2.

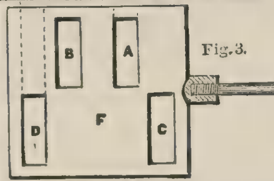


Fig.3.

¾ in. = 1 foot.

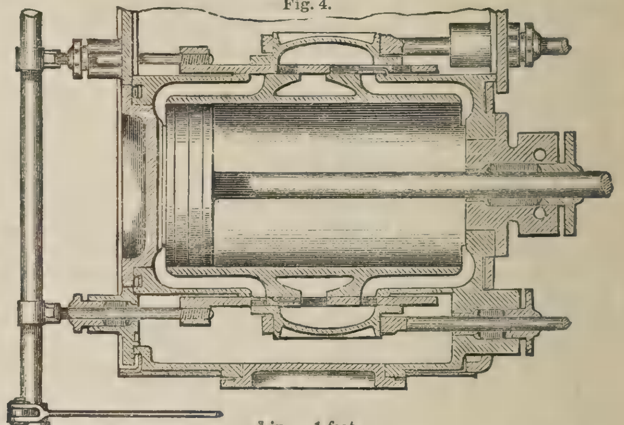
The mouth-piece is attached to the cylinder-face by bolts with dovetailed heads, so that it may be easily taken off, examined, and replaced at any time.

Two objections may be taken to this plan: the first of which is, that in reversing, the lead is lost; indeed, as it is easy to see, the valve will be just as much behind the piston in its backward movement as it is before it in going forward, supposing the engine to be working with lead. The second is, that when one or other of the cranks happens to be on the centres at the time the reversing-valve is shifted, for the first few moments that the engine is in motion the pressure on one piston will be opposed to that on the other. This will be rendered obvious by attentively examining the engraving annexed, showing that, when a crank is in this position, the driver must be cautious to reverse slowly.

The second plan has been supplied to us by Mr. James Hall of Newcastle, and is the invention of Mr. George Ogle, of the establishment of Messrs. Hawthorn, in that town.

Fig. 4 exhibits a longitudinal section of a locomotive engine cylinder, with the steam-slides and reversing apparatus attached. Each cylinder has two valve-chests and slide-valves, the latter being worked by separate eccentrics, set to give a back and forward motion respectively, as is usual with the ordinary arrangements. The slide-valves do not, however, work upon the face of the cylinder, but upon an adjustable brass plate, ground to lie steam-tight upon the face.

Fig. 4.



¾ in. = 1 foot.

As drawn in our engraving, the engine is supposed to be in the forward gear, running ahead—the outside valve being in action through its outside forward eccentric. The steam finds ingress and egress to and from the cylinder in the usual manner, passing through the ports in the adjustable plate, which are now set exactly to agree with those in the cylinder-face. The engine thus works with its full lap and lead as given by the eccentric.

When the engine is to be reversed, all that is necessary to do is to turn the cross shaft at the bottom of the cylinder by the proper reversing lever on the driver's foot-plate, when the two adjustable plates of the valve-chests are at once transposed, the one in the inner valve-chest being altered so as to uncover the ports in the cylinder-face, whilst that in the valve-chest for the forward movement is drawn out so as to cover up the cylinder ports beneath it. This movement at once reverses the engine correctly; for as each slide-valve is set with its true lap and lead, the backward motion will be equally as efficient as the forward one. As both slide-valves are always working during the running of the engine, it becomes an object to diminish the friction and loss from this double working as much as possible. Accordingly, to allow of each valve working free of steam pressure during the time it is out of action, or working to no end, a narrow passage is formed in the body of the adjustable slide, so as to form a communication between the valve-chest and the central or exhaust-port of the same slide; so that, when either of the valves is out of action, as in the case of the inner one now before us, the steam pressure on the back of the slide is balanced by the admission into its hollow, of steam from the valve-chest. In the outside valve this passage is closed up by its port being brought into contact with the cylinder-face, so that the steam cannot find its way into it. By this simple means, each slide-valve, as it is thrown out of active employment, although still worked by its eccentric, has its steam pressure almost entirely removed from it, and it therefore works with little greater resistance than that resulting from its own weight.

Mr. Ogle's arrangement is certainly most effective, and accurately correct, amounting, in fact, to neither more nor less than a double-valved cylinder. The objections which strike us here are the increased expense involved in a double set of valves, and the wear and tear, frictional loss, and trouble attending two arrangements. Both valves are always working; and although the one which is out of action has little pressure upon it, yet this cannot be wholly neutralized in the way we have shown.

The advantages are, the obtainment of great accuracy of working for both directions of movement, and the direct system of connection of the eccentric with its valve-spindle, whereby one joint only is required in place of three, as in the expansion-link arrangement, and thus the proper set and lead of the valves is not by any means so soon lost by wear upon the joints.

In other respects, nothing is to be urged in its favour on the score of economy of construction, for the usual complement of four eccentrics is necessary; and to balance the absence of the link or other reversing movement, the valve apparatus is doubled. The reversing action is simple and easily managed; nothing more being necessary than the drawing in or out of the two spindles of the reversing plates.

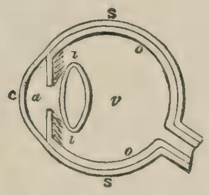
The two plans have nothing in common between them, for one proposes to simplify the valvular apparatus by adopting means which involve a certain amount of inaccuracy, whilst the other endeavours to arrive at the perfection of working by an addition to the mechanism at present employed.

THE TELESCOPE.

The telescope (τηλε, at a distance, σκοπειν, to see) is an optical instrument, employed to enlarge the sphere of vision, by collecting upon a broad surface, the pencils of light proceeding from distant objects, and carrying them into the eye. The apparent effect is as if such objects were magnified, or brought nearer. We shall best discover the real principle of the telescope by a preliminary examination of the structure of the eye—the organ by which we become cognizant of light, and its manifold phenomena.

The eye is lodged in a cavity of the skull, named the socket or orbit. Its form is nearly spherical, and it is fixed and moved in its place by six muscles. In man, and most animals, it consists of four principal envelopes, the sclerotic and choroid coats, the cornea and retina; and of three humours or refringent media, the aqueous, crystalline, and vitreous. The sclerotic coat (see fig. 1, s s), a thick and fibrous membrane, forming the exterior envelope of four-fifths of the ball, is pierced in front by a circular aperture, through which the light is admitted into the chamber of the eye; and behind, by another aperture, through which the optic nerve enters from the brain, to receive the impressions of light admitted by the opening in front, after its rays have been modified by the curious apparatus with which that chamber is fitted up. To the sclerotic coat are attached the muscles by which the eye is moved in its socket. Over the anterior aperture is placed the cornea, c, a tough but thin and transparent membrane, which projects slightly forward in a curve of a smaller radius than the rest of the ball. The inside of the sclerotic coat is lined with the delicate choroid coat, which is charged with brown or black matter, apparently with the view of preventing the luminous rays from entering at any other place than the opening in front. The retina is a fine network, formed by an extension of the optic nerve, o o, spread over the inner surface of the choroid membrane. This forms, as it were, the canvas upon which the pictures of the exterior world are painted—the plate lodged in its dark recess, prepared for the reception of photographic impressions from without. A membrane, shaped like a flattened ring, is placed a short distance behind the cornea, and divides the interior of the eye into two chambers of unequal size, termed the anterior and posterior chambers. This is the iris; it surrounds the front aperture or pupil, and is endowed with a power of expanding and contracting, so as to regulate the quantity of light admitted through the pupil, according to the wants of the organ. The space between the iris and cornea is occupied by a transparent fluid, called the aqueous humour, *a*. Behind the iris is inserted a lens, *ll*, with faces of unequal curvatures, composed of the crystalline humour in a transparent case. The whole of the posterior chamber, occupying the greater part of the eye-ball, is filled with the vitreous humour, *v*. Looking at an eye in front, the dark centre forms the pupil; this is the aperture in the sclerotic coat seen through the cornea. The circular band of blue, grey, or brown tint, is the iris—by the contraction of which, the size of the aperture is made greater or less. The sclerotic coat is seen in the white.

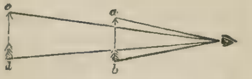
Fig. 1.



When the eye is directed to an object, rays proceed from every part of it, and enter the eye by the pupil. Then traversing the different media, they undergo the refraction and convergence necessary for their due effect upon the retina; by which, as soon as they fall upon it, the impression is conveyed by a communication of nerve to the brain, and then the optical picture becomes a perfect sensation. It is a very singular fact, that the images thus thrown upon the retina are reversed, and it is only by an operation of the mind, that the objects themselves are seen in their proper position.

The apparent size of an object is determined by the angle formed at the eye by the rays proceeding from that object, and as such angle must necessarily be less, the further an object is distant, so will the apparent magnitude be less. For example, the angle under which an eye sees the object, *ab*, (fig. 2,) is much greater than the angle under which it sees another object of the same size, but at twice the distance, *cd*. The mathematical expression of this law of vision is, that the apparent size of objects is inversely as the squares of their distances. Now, it will be evident, that the visual angle (*i. e.* the angle under which any object is seen) will be in proportion to the size of the aperture through which the rays enter the eye, and if we could increase the dimensions of the aperture, we should increase also the apparent size of an object within the field of vision. This office the telescope virtually does for us, by collecting the visual rays upon a surface larger than the pupil, and then transmitting them into the eye, by virtue of the laws of refraction or reflection. The surface upon which they are so collected thus operates as an advanced pupil; and if none of the rays were lost in the process of refraction or reflection, the magnitude of the object would be increased as many times as the collecting surface is larger than the real pupil.

Fig. 2.

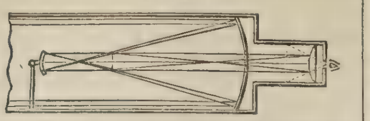


It is a disputed point who was the first inventor of the telescope, that honour having been claimed for Giovanni Baptista Porta—Jansen, a spectacle-maker at Middelburg—and others. The invention is usually dated in 1590. In 1609, the illustrious Galileo, who was then at Venice, having heard that they possessed in Holland the art of making an instrument by which distant things seemed brought near, set his mind to work, and succeeded in combining two lenses, one convex, the other concave, in a tube of lead, which answered in some degree that purpose. The instrument magnified only three times; but it served to stimulate the philosopher to make further efforts, which ended in his constructing others of greater power, that enabled him in a few years to enlarge considerably his knowledge of the solar system, and of the starry spheres beyond. He discovered the inequalities of the moon's surface, four of Jupiter's satellites, the sun's rotation on an axis in 25 days, and the phases of Venus. The visible stars of the Pleiades increased from seven to forty. The common opera-glass is an adaptation of the Galilean form.

The Dutch philosopher, Huyghens, was the next person to whom we are indebted for improvements in the telescope. With instruments of enlarged size and power, he discovered, in 1655, that Saturn had a satellite, and, the following year, that the planet was wondrously surrounded by a ring. Pursuing his experiments, he contrived, by dispensing with a tube, to make use of lenses more than 120 feet apart. Meanwhile the Italians were pushing their researches, and Campani of Bologna constructed telescopes 34, 86, and 140 feet long; which, in the hands of Cassini, revealed, between 1671 and 1684, four more satellites of Saturn. Louis XIV. patronised Campani, and induced him to execute his 140-feet instrument, by means of which Cassini saw the dark line which appears to divide Saturn's ring into two, and a dark belt upon the body of the planet. A combination of two convex lenses was found to increase, like the Galilean telescope, the apparent angle under which an object was seen, but in this case the image of the object is inverted. The lenses must be so placed, that the distance between them is equal to the sum of their focal distances. In astronomical observations, the inversion is of no consequence; and at sea, when it is of importance to lose as little light by refraction as possible, an instrument containing only two lenses, called the Night Telescope, is frequently used. The lens next the eye is called the eye-glass, that at the other end of the tube is the object-glass. The common day telescope has the addition of other lenses, for the purpose of placing the image in an erect position.

All the telescopes hitherto mentioned were dioptric or refracting telescopes, that is, combinations of glass lenses. But the difficulty in making large lenses of good glass, and the unwieldiness of telescopes of such a length, induced mechanicians to turn their attention to the construction of telescopes on another plan. In 1663, James Gregory of Aberdeen gave to the world an account of a reflecting telescope he had made, which consisted of a concave metallic mirror, or speculum, of a parabolic form, with its face turned towards the object to be viewed, and an aperture at the middle. A small concave speculum, of an elliptical form, was placed further down the tube, facing the larger one. The accompanying figure will show the paths of the rays of light in the Gregorian telescope. By this contrivance, an image was brought through the aperture behind the

Fig. 3.



large speculum, where it was magnified by an eye-piece. Sir Isaac Newton, in 1666, improved this construction, by placing the opening where the eye is placed at the side, instead of at the end of the tube, and it then became unnecessary to have an aperture in the larger speculum. Newton's first instrument was only six inches long; but it answered as well as a six-foot refractor, magnifying forty times. In 1721, John Hadley, a country gentleman, who had studied Newton's optics, presented to the Royal Society a telescope he had made, which was six feet in length, and possessed the power of magnifying nearly 200 times. This gentleman taught Molyneux and Bradley the art of grinding and polishing metallic specula, and the two together made a telescope eight feet long, at Kew; but this was exceeded by instruments, which an ingenious mechanician, named Short, constructed about the middle of the eighteenth century. One of these he sold to the King of Spain for £1,200.

When the great modern discoverer in astronomy, Sir William Herschel, began to examine the heavens, it was with a telescope constructed by himself. In his desire to remove the imperfection of the instrument as he found it, and to increase its powers, he feared no amount of labour. He cast, ground, and polished 200 specula of 7 feet focus, 150 of 10 feet, and more than 80 of 20 feet, all of the Newtonian form. The first was completed in 1774, and he soon began those wonderful discoveries which have made his name foremost in the list of astronomical observers. In 1785 he commenced, and in 1789 completed, his 40-feet reflector, with a speculum 4 feet in diameter. This enormous instrument was erected at the expense of George III., at Slough, near Windsor. Its iron tube was 4 feet 10 inches wide. The discoveries of Sir William Herschel with these splendid instruments belong to the history of astronomy, and an account of them would be out of place in our rapid sketch. In the meanwhile, the improvement of the refracting instruments had been again pursued. Their principal defects were spherical aberration, *i. e.* the malformation of their pictures in consequence of the borders of the lenses having a shorter focus than the centre, and the discolouring of the images, termed chromatic aberration. John Dollond, in 1758, began to manufacture the achromatic telescope, in which, by using two kinds of glass (flint and crown) with different refractive powers, the discolouring of the images was corrected, and the spherical aberration of the convex lenses was diminished, by the opposite aberration of a concave lens. The difficulty of making flint glass free of flaws still stood in the way of constructing lenses of a large size; but a Swiss clockmaker succeeded, after immense labour, in obtaining pieces of glass, of uniform transparency and refractive power, with considerable diameters; and, being invited to Munich, he was employed by Frauenhofer, whose establishment afterwards became so famous for the manufacture of optical instruments, which are in use at most of the continental observatories. Telescopes, with object-glasses of 10 and 12 inches diameter, were sold by Frauenhofer to the Emperor of Russia and the King of Bavaria. The expense of making such instruments is very great. Frauenhofer estimated the expense of an achromatic telescope, with an object-glass 18 inches in diameter, at £9,200.

We now come to the labours of the Earl of Rosse. His lordship, having resolved to try his utmost to construct a reflecting telescope, such as should exceed every previous instrument, commenced his experiments about 1827. He began with casting specula of a small size, and gradually increased their dimensions. But he found that he could not get beyond a certain size, by reason of the specula, made of the common alloy, cracking in the process of cooling. His first expedient for surmounting this difficulty was to cast a speculum in several pieces, and then to solder them together. But he still entertained the hope that he might discover a new alloy, by means of which he could cast, in a single piece, a speculum three feet in diameter; and, at length, he found that 126·4 parts of copper to 58·9 of tin would answer his purpose, provided he could have a mould, the lower surface of which could be cooled, whilst the upper retained its heat. The metal, being extremely brittle, was apt to crack from the too rapid cooling of the edges, and, moreover, air-holes were formed in the plate, which must be got rid of by grinding out—a troublesome process. At length, after repeated trials, he adopted the plan of making the upper surface of the mould of sand, and the lower of pieces of iron-hoop placed side by side, with the edges uppermost, and closely packed within an iron frame. The air was thus allowed to make its escape, whilst the metal was properly retained in the mould; and so successful was the expedient, that of 16 plates intended to form a 3-feet speculum, not one was defective. Equally successful was the attempt to cast a speculum three feet in diameter in one piece.

The proper proportions of metal having been found, and the mechanical difficulties of casting overcome, there remained to discover some method of giving to the reflecting surface such a curve as would obviate aberration. It became advisable to have a steam-engine in order to obtain the necessary degree of power in grinding and polishing large specula, and ingenious machinery was invented to effect these operations. The form of curve required to reflect all the incident rays to the same focus was a parabola, and Lord Rosse completely succeeded in making his machinery communicate the true curve to his specula. A telescope of 26 feet in length, with a 3-feet reflector, was thus executed with the exercise of much patience and ingenuity. No sooner was it completed, than its maker commenced another on a still more gigantic scale, viz., with a length of 50 feet, and a speculum 6 feet in diameter. The execution of this instrument also met with entire success. Such was the perfection to which Lord Rosse had brought the working of his machinery, that this enormous mirror, which weighs nearly 4 tons, was polished in six hours. The width of the wooden tube is 6½ feet, large enough to permit a learned mathematician to walk through it with an opened umbrella; and the whole weighs about 12 tons. This instrument is placed between two walls 60 feet high, one of which carries the galleries for observers. The horizontal range through which it can be moved is only about 14 feet; but it can be raised from the horizon to the zenith, and all its movements are effected with facility. When the strip of sky which it commands has been thoroughly examined, another arrangement must be made to subject a further portion to its investigations. The reflecting area of Herschel's 4-feet speculum contained about 2,300 square inches, that of Lord Rosse's 6-feet speculum contains about 5,180 square inches. The assistance which the science of astronomy will derive from these telescopes will doubtless be very great. The observer will be able to penetrate deeper into space, and to reach down to worlds which had never before been seen. They will give us more minute information as to the bodies which less powerful instruments had previously discovered, and already has one daring hypothesis crumbled away before them.

There are several modes of estimating the power of a telescope:—1*st*. A comparison of the quantity of light it transmits to the eye with what the unassisted vision receives. 2*d*, Its power of penetrating into the depths of space beyond that possessed by the naked eye. 3*d*, The increase of apparent magnitude which it gives to objects over that which they have when viewed by the unaided sight. These may severally be used to express the measure of telescopic power. The ratio of the *clear area* of the aperture of the telescope to that of the pupil (supposing all the light which enters the former to be transmitted through the latter), would express the *optical power* in conformity with the first means of estimate. The ratio of the *diameters* of the same apertures—in other words, the ratio of the square roots of the former—would give the second mode of measurement. "If we conceive the light that issues from a star or luminous object, to be uniformly spread over the surface of a perpetual succession of spheres, whose centres are the common source of emanation, the same aperture of the same telescope, placed at different distances from it, will admit quantities of light which are proportional to its intensities on the surfaces of the corresponding spheres of dispersion, and therefore universally proportional to the areas of those surfaces over which the same quantity of light is distributed; or, in other words, to the squares of their radii. It would consequently follow, that the *space-penetrating power* of the telescope would be measured by the simple ratio of the radii of the spheres of dispersion, or by the distances at which the same quantity of light would be transmitted to the retina by the telescope in one case, and by the unassisted pupil of the eye in the other. Thus, if the extreme distance at which a star of the first magnitude would first become visible to the naked eye was denoted by 1, the power which we are seeking to express would be represented by the multiple of that distance at which the same star would first become visible when seen through the telescope; consequently, if the aperture of the pupil of the eye was assumed to be two-tenths of an inch, a telescope of four inches aperture, if no light was lost in its passage through it, would increase the range of natural vision 20 times, and its *optical power* would be represented by 400."

Light, however, is lost on being transmitted through a lens, and there is a still greater loss when it is reflected from a metal mirror. The loss in the first case may be estimated at 5 per cent., in the second, it has been found by experiment to be as much as 23 per cent. This great loss in the case of metallic surfaces, led to Herschel's contrivance for dispensing with the second mirror which he found in the Gregorian telescope.

It would appear from the researches of astronomers, that a star of the sixth magnitude is twelve times as distant from us as Sirius, if we assume that all stars are equal in magnitude and brightness when placed at the same distance from the observer. In other words, let Sirius be pushed away from us twelve times as far as he is now distant, and he would shine only as a star of the sixth magnitude, and, as such, would be visible to the naked eye. Remove the same star seventy-five times as far again, (that is, to the 900th order of distances,) and though it would long have ceased to be visible to unassisted vision, yet it could be again recovered by Herschel's 20-feet reflector, and Lord Rosse's telescope of 6-feet aperture would enable the star to be seen when it had been removed to the 3,436th order of distances.

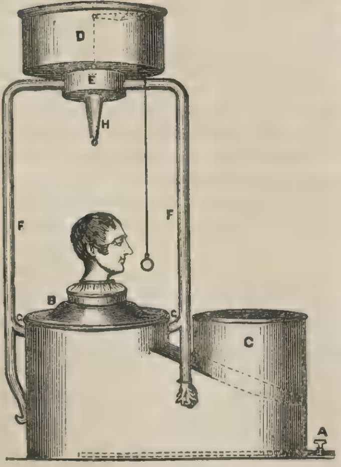
But the optical power will not be accurately measured under all circumstances by a comparison of the quantity of light transmitted through the pupil by a telescope, and that transmitted without its aid. The magnifying power of the instrument affects the optical power to an extent which it is not easy to estimate. Stars are rendered visible with higher magnifying powers when they are invisible with lower, whilst the aperture of the telescope remains the same in both cases.

"There is no instrument or machine of human invention (says an eloquent writer with reference to the telescope), so recondite in its theory, and so startling in its results. All others embody ideas and principles with which we are familiar, and however complex in their construction, or vast in their power, or valuable in their products, they are all limited in their application to terrestrial and sublunary purposes. The mighty steam-engine has its germ in the simple boiler in which the peasant prepares his food; the huge ship is but an expansion of the floating leaf, freighted with its cargo of atmospheric dust; and the flying balloon is but the infant's soap-bubble, lightly laden and overgrown. But the telescope, even in its most elementary form, embodies a novel and gigantic idea, without an analogue in nature, and without a prototype in experience. It enables us to see what would for ever be invisible. It displays to us the being and nature of bodies which we can neither touch, nor taste, nor smell. It exhibits forms and combinations of matter, whose final cause reason fails to discover, and whose very existence even the wildest imagination never ventured to conceive. Like all other instruments, it is applicable to terrestrial purposes; but, unlike them all, it has its noblest application to the grandest and remotest works of creation."

GOODMAN'S HYDRO-VAPOUR BATH.

A very objectionable feature in the use of warm or vapour baths, is the relaxed, and consequently susceptible condition of the exhalants or secerning vessels of the skin, thus produced, rendering them not only inoperative as remedial agents, but frequently positively dangerous.

It has, however, long been known amongst the wild Indians of America, the Esquimaux, as well as by the Russians—and the fact is now fast receiving the acknowledgment of civilized nations—that this relaxed condition may be removed, whilst the skin is still heated, with perfect safety and ease, and any degree of tonicity may be given to the skin, simply by an instant ablution with chilled or cold water. The results of this system of treatment in many complaints, more especially those originating in cold, as well as rheumatic affections, have been quite extraordinary.



To facilitate the carrying out of this idea, Mr. John Goodman, of Manchester, has originated a compound bath, which he terms the "hydro-vapour, or anti-rheumatic bath," of which our engraving exhibits an elevation. The advantage of his arrangement is, that the patient may, whilst sitting in the steam bath, and without any intervening change or exposure of the body to the atmosphere—the only source whence cold is to be feared—be submitted to an ablution of chilled or cold water, either in the form of a stream or shower, as may be chosen. The new bath possesses much of the form of an ordinary slipper bath; it receives its steam from the cock, A, forming the entrance to the line of perforated pipes, shown dotted along the bottom of the bath. To the upper part of the body of the bath, a tin cover, B, is fitted, having a hole in the centre, and this is provided with an elastic neck-piece, embracing the neck in an air-tight manner, preventing the escape of vapour. C, Is the cold water reservoir, placed upon the closed top of the narrow end of the bath, in which top is a valve for the admission of the cold water to the interior. D Is a second reservoir for cold or tepid water, which, upon raising the valve, E, by means of the pendant cord, will flow down the pipes or tubular pillars, F F, and by the short connecting tubes, G G, into the bath, where it impinges upon the body when enveloped in vapour.

When the contents of both reservoirs are admitted into the bath, it forms an ordinary "shallow bath," with from four to six inches of water. Whilst seated in the bath, a "douche" may be obtained from the central tube, H, by drawing the cord as before, when the bottom stopper is removed; or a stream may be directed on the back, in place of employing a jug for this purpose.

The reservoir, D, serves the purpose of an ordinary "sitting bath," and the body will also answer at any time when a warm, tepid, half, or full bath is required, presenting, in a compact space, the principal forms of bath used in hydropathy.

EXPERIENCE TEACHES.

The every-day conflict between theory and practice is unfortunately too often misunderstood, as well by the beginner and amateur as by many a well-meaning man of business, not to provoke frequent remarks upon so fruitful a source of error. A lurking and totally unacknowledged idea is unwittingly entertained by many sanguine and ingenious inventors, that their knowledge or theory is so perfect, that practice must perforce coincide with their opinions of what ought to happen. Arguments are so well adduced on their side of the question, that it is with extreme difficulty that any one can disprove their statements, until the actual facts plead for themselves;—like the philosopher who denied motion, because a body cannot move where it *is*, and, it is very evident, it cannot move where it *is not*, therefore, said he, there cannot be any motion. We are not sure that this mode of reasoning can be met by argument; but our profound philosopher, returning home in the dark, knocked out two of his teeth by running against a post; he then thought there *must* have been motion in one body or the other, but was still unable to reconcile his theory and practice.

Most "practical blunders" have arisen from this idea; and the great mischief lies in the strength with which it has seized hold of men's minds, whence long years of toil, nay, a life of labour, and thrifty accumulations of bygone generations, are all wrecked upon an unsubstantial theory, very pretty upon paper—not to be upset by argument—and not reducible to practice. That our ideas require the test of experiment, and that our reasonings and theories are, at best, but strivings after truth, needs not to be asseverated. Let him who pleases carry on his speculations, adding one *unanswerable* argument to another, without any direct appeal to the oracles of nature, and he will only raise his theories as children erect card-houses, to be knocked over by the first puff of trial. But the philosopher who, as he proceeds, tests his theory, step by step, by experiment; and who always accepts a fact for a fact, and not "just turning it a trifle" to fit his notions, will build on a safe foundation, finding, as others have found before him, that "there are things in heaven and earth not dreamt of in *their* philosophy." How often does John Bull bless the practical and inquiring man who first ventured to eat an oyster! Who knows how his theoretical brethren, backed by their obstinate go-on-as-before practical companions, might have endeavoured to dissuade him from the absurdity of his attempting what no one had ever attempted before; and how they might have out-argued him by learned analogical reasons, that, as other raw fish were not good food—*ergo*, an oyster, having nothing of importance to distinguish him from a mussel, could not, and most certainly ought not, to be fit to eat in his natural uncooked state. But practice perfects, even in eating raw oysters.

Whilst we shun the mere theorist, we must keep at an equal distance from the blockhead who prides himself upon his panoply of ignorance, and, elevated by his vacuous head, styles himself a "practical man." Theory and practice, like the two halves of a pair of scissors, must be united to be useful. Few practical men would have ventured upon the construction of Stephenson's tubular bridge; and fewer theorists, or practicians either, would have made the top of the tube stronger than the bottom: yet such an arrangement has resulted from theory and practice. The first incited the trial—the second pointed out the weak points.

The schemer will often put his plan on paper, try it by a rule and compass, and call *that* practice; the black-lead pencil he uses might of itself teach him the value of experiment, for he would not have been able to make his sketches with nearly the same facility, if the obliterating properties of india-rubber had not been *tried*. He may even make a model—a real working model—and still forget the difficulty of finding a reason why the water he applies to his turning-tool should assist so very materially in the cutting and polishing his iron, and any consideration of the part played by the pinch of charcoal in his steel would only add to his dilemma. The theorist, in his turn, may laugh at the so-called "practical" man, who puts a lift-pump down a deep well, and finds he cannot raise the water; or who erects a cistern at the top of a very lofty building, and in drawing water from it in the cellar, finds, to his amazement, that the pipe is burst every time he turns the cock. The ancestors of these same practical men were accustomed to carry their corn to market by slinging the sack on one side of the horse, and balancing it by a stone on the other—because their fathers did so before them. But times are now so changed in these days of the schoolmaster, that the present race of these geniuses are continually inventing, or perhaps modestly suggesting, a perpetual motion, by means of a syphon, with one leg "much shorter, but also very much larger," than the other, intending the long and narrow, and consequently light, strip of water to be drawn up by the short and heavy column. Another class of practical men, so nearly allied to their better-instructed brethren, and so patient and ingenious, that their case always demands our pity and respect, and never our ridicule, are those inventors of useless complications of *more* than all the mechanical elements; as, for instance, the contriver of the differential or multiplying motion, figured at page 151, vol. i. As we hope that, in our own case, the maxim, *experientia docet*, has taught us some degree of practical wisdom, we would request the attention of the junior portion of our readers to a trifle of what is so often given away—advice. We have had some practice in the direction of several mechanical and chemical operations, and have met with our share of obstacles in attempting their improvement, but never, at any time, have we derived any benefit from riding rough-shod over old and long-tried plans and contrivances. On the contrary, success has often been the result of testing each step in our march: now the advance has been an inch, and anon a yard; and all thus gained is secure—there is no danger of being beaten back from our position.

Fortified, then, by our experience, and authorised by—we will not say how many—blunders and grey hairs, we advise the careful consideration of all practical facts. Be content to take a fact for a fact; not twisting it, however little, to fit some favourite theory, but accepting it purely as a fact, until, by constant perseverance, both in theory and practice, a peep can be obtained behind the scenes, for the revelation of that which is not apparent to a more public and superficial inspection.

D.

SULPHURIC ACID.

The following tabular statement of the relative proportions of acid and water in a bulk of a given specific gravity may be found useful in testing. The table originally formed a portion of the lecture delivered at Manchester by Mr. Calvert, and reported at page 9, *ante*.—

Sp. Gr. of Acid Water being 1000.	Acid in 100 Parts.	Water in 100 Parts.
1,845	81,68	18,32
1,725	68,62	31,38
1,618	60,70	39,30
1,603	59,62	40,38
1,586	58,36	41,64
1,566	56,83	43,17
1,550	56,01	43,99
1,532	54,69	45,31
1,515	52,79	47,21
1,500	51,50	48,50
1,482	50,19	49,81
1,466	48,58	51,42
1,454	47,42	52,58
1,375	41,19	58,81
1,315	35,31	64,69
1,260	29,95	70,05
1,210	26,70	73,30
1,162	19,69	80,31
1,114	14,26	85,74
1,076	9,62	90,38
1,023	5,42	94,58

EXPERIMENTS ON SCHIELE'S ANTI-FRICTION CURVE.

As we proposed at page 50, *ante*, we now give some further examples of the adaptation of Mr. Schiele's anti-friction curve to practical purposes.

To afford a comparative test of the effect produced by the new curve, in relation to that of ordinary rubbing surfaces, the inventor formed a variety of frictional contours of equal diameters from the same cast of iron, carefully annealed, and compared each of them separately, under different pressures, in the direction of their axes, with the proposed curve.

Fig. 1, of our engravings, represents a sectional view of the different forms tested; and fig. 2 exhibits the same after wear, confirming the good opinion which we expressed of it in our former paper.

Fig. 1.

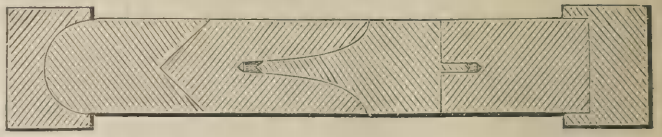
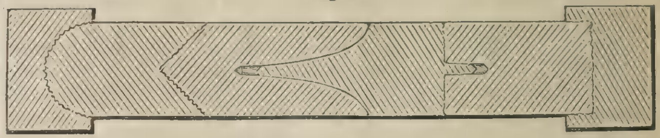


Fig. 2.



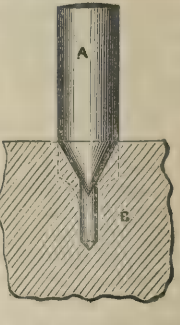
In some instances, the old forms evidenced a less amount of friction than the new one, but this was for a limited period only at the commencement, as very quickly the destructive wear, increasing towards the centre, caused so much friction that the parts adhered firmly together.

The cause of the destructive wear of the old shapes is very clearly explained by the action of the new curve, as it shows the proportions of friction, to which the constant wear tends to bring the different points of the acting surfaces, giving the best evidence that when the friction is equally divided over all points, the curve in question is arrived at. The experiments also show, that for equal pressures a considerably smaller size of curve will answer, and this is a point of great importance.

The conformity of this principle with the workings of nature is a circumstance arguing most favourably for the application of the new system; and the following experiment, which any one may easily try, affords the evidence required by the practical man.

Take two pieces of chalk, A and B, fig. 3; A cylindrical and conically tapered on one end, which is made to fit nicely into B. The centre of the hole in B must be drilled out, and the two pieces rubbed against each other, the rubbing surfaces being cleared occasionally with a soft brush, removing any particles of sand which may scratch one or other of the surfaces. After continuing the movement for a short time, the inclination to the anti-friction curve gradually appears, and the longer the rubbing is continued, the nearer do the surfaces approximate to the contour referred to. The dotted lines in fig. 3 illustrate what is meant. Mr. Schiele offers to show the apparatus he has employed, together with the results obtained, to any one who may wish to pass his own judgment upon the idea, as reduced to practice.

Fig. 3.



Regarding the curved form as being produced by friction, the generating curve ought to be called *friction curve*, as originally named by the inventor; but in its practical application for the diminution of friction and wear in machinery, the term anti-friction curve, as given by us, is certainly more proper.

We may here correct a slight misrepresentation occurring in our former notice. The remarks accompanying figs. 3 and 4 refer to the spindle of a locomotive engine regulator, where it is passed into the fire-box; but a slightly different application is exhibited in the cuts—namely, the stopcock of a knee-pipe.

BOTANY.

THIRD ARTICLE.

Classification of Plants.—Linnæus was acquainted with no more than 8000 plants. The number of plants now described by naturalists amounts to upwards of 75,000 species. It becomes desirable, therefore, to adopt some mode of classifying them, so as not to be confused in this immense number of objects, which, amid all their differences, have more or less resemblance to each other. Many systems of classification have been proposed with different objects in view. Some, called *empirical*, are unconnected with the organization of plants; such is the classification in alphabetical order. Others are founded upon some one of the properties of plants; such are the medical or industrial classifications. The physician, for example, will divide plants into emollients, astringents, purgatives, &c., whilst the economist will arrange trees according to the usefulness of their wood in the arts.

The naturalist proposes two ends: 1. To class plants so as to be able easily to find the name of any one which he may meet with; this is the aim of all *artificial* systems. 2. To class plants according to their natural resemblances and affinities; and this is the endeavour of the *natural* systems. Linnæus' arrangement proceeds on the former plan: Jussieu's, developed by De Candolle and Professor Lindley, on the latter.

The Linnæan System.—Linnæus arranged vegetable forms in two divisions, viz., plants having visible flowers (phænogamia), and plants having no visible flowers (cryptogamia). The first division he subdivided into classes and orders, founding his arrangement on the number and position of the stamens and pistils, and hence called the sexual system. Since this system has been much used in England, on account of its forming a convenient index to plants, enabling botanists readily to find out their names, we subjoin an outline of it:—

Of the plants bearing stamens and pistils, he made 23 classes, to the first 13 of which he gave names compounded of a Greek numeral, and the word which, in that language, signifies male. To the orders of those classes he gave names compounded of Greek numerals and of the word signifying female. The class-name refers to the stamens; the order-name to the pistils.

1st Class.—(*Monandria*) one stamen. 1st Order (Monogynia), one pistil; 2d Order (Digynia), two pistils.

2d Class.—(*Diandria*), 2 stamens. 1st Order (Monogynia), one pistil; 2d Order (Digynia), 2 pistils; 3d Order (Trigynia), 3 pistils.

3d Class.—(*Triandria*), 3 stamens; 3 orders, Monogynia, Digynia, Trigynia.

4th Class.—(*Tetrandria*), 4 stamens; 4 orders, Monogynia, Digynia, Trigynia, Tetragynia (4 pistils).

5th Class.—(*Pentandria*), 5 stamens; 6 orders, Monogynia, Digynia, Trigynia, Tetragynia, Pentagynia (5 pistils), Polygynia (many pistils.)

6th Class.—(*Hexandria*), 6 stamens; 6 orders, Monogynia, Digynia, Trigynia, Hexagynia (6 pistils), Polygynia.

7th Class.—(*Heptandria*), 7 stamens; 4 orders, Monogynia, Digynia, Tetragynia, Heptagynia (7 pistils.)

8th Class.—(*Octandria*), 8 stamens; 4 orders, Monogynia, Digynia, Trigynia, Tetragynia.

9th Class.—(*Enneandria*), 9 stamens; 3 orders, Monogynia, Trigynia, Hexagynia.

10th Class.—(*Decandria*), 10 stamens; 5 orders, Monogynia, Digynia, Trigynia, Pentagynia, Decagynia (ten pistils.)

The preceding classes have a fixed number of stamens, but the next three classes have stamens less certain in point of number.

11th Class.—(*Dodecandria*), 11—19 stamens, inserted into receptacle; 6 orders, Monogynia, Digynia, Trigynia, Tetragynia, Pentagynia, Dodecagynia.

12th Class.—(*Icosandria*), 20 stamens and upwards, inserted on calyx or corolla; 5 orders, Monogynia, Digynia, Trigynia, Pentagynia, Polygynia.

13th Class.—(*Polyandria*), 20—100 stamens, inserted into receptacle; 7 orders, Monogynia, Digynia, Trigynia, Tetragynia, Pentagynia, Hexagynia, Polygynia.

In the two next classes, two of the stamens are shorter than the others, and the names refer to the number of stamens which are taller than the rest.

14th Class.—(*Didynamia*), 4 stamens, inserted on a monopetalous corolla, 2 taller; 2 orders, Gymnospermia (4 seeds not in a seed vessel), Angiospermia (4 seeds in a seed vessel.)

15th Class.—(*Tetradynamia*), 6 stamens on a polypetalous corolla, 4 taller; 2 orders, Siliculosa (seeds in a silicle, or short pod), Siliquosa (seeds in a long round pod.)

In the next three classes, the stamens are joined by their filaments, and the names refer to the number of bundles or brotherhoods into which they are united The names of the orders refer to the number of *stamens.*

16th Class.—(*Monadelphia*), 1 bundle of stamens; 8 orders, Triandria, Pentandria, Heptandria, Octandria, Decandria, Endecandria (11 stamens), Dodecandria (12—20 stamens), Polyandria (more than 20 stamens.)

17th Class.—(*Diadelphia*), 2 bundles of stamens; 4 orders, Pentandria, Hexandria, Octandria, Decandria.

18th Class.—(*Polyadelphia*), 3 or more bundles of stamens; 3 orders, Dodecandria (12—25 stamens, not connected with calyx), Icosandria (stamens connected with calyx), Polyandria (more than 25 stamens, not connected with calyx.)

In the first of the next two classes, the stamens are joined by their anthers; in the second, the stamens and pistils are all united.

19th Class.—(*Syngenesia*), composite flowers, viz., a number of florets within a common corolla; 4 orders, Polygamia æqualis (florets equal); Polygamia superflua (florets of circumference, having only pistils); Polygamia frustanea (florets of circumference, with neither stamens nor pistils;) Polygamia necessaria (florets of circumference, only pistils, florets of centre, only stamens); Polygamia segregata (florets with separate calices inserted within a common calyx.)

20th Class.—(*Gynandria*), stamens placed upon the stylus or ovary of the pistil; 8 orders, Monandria, Diandria, Triandria, Tetrandria, Pentandria, Hexandria, Heptandria, Octandria.

21st Class.—(*Monœcia*), stamens and pistils in different flowers on same plant; 9 orders, Monandria, Diandria, Triandria, Tetrandria, Pentandria, Hexandria, Polyandria, Monadelphia, Gynandria.

22d Class.—(*Diœcia*), stamens and pistils upon different plants; 14 orders, Monandria, Decandria, Isocandria, Polyandria, Monadelphia, Gynandria.

23d Class.—(*Polygamia*), stamens and pistils, both together and separately, on the same plant; 2 orders, Monœcia, Diœcia.

24th Class.—(*Cryptogamia*), stamens and pistils invisible; 5 orders, Ferns (Filices), Mosses (Musci), Liverwort (Hepaticæ), Seaweed (Algæ), Funguses (Fungi).

The Natural System.—The vegetable kingdom is divided by the natural system into two great branches:—vascular or phanerogamous plants, termed *Cotyledones*, and cellular or cryptogamus, termed *Acotyledones*. Vascular plants are formed of cellular tissue, and vessels with leaves furnished with stomata. They have a root and a stem, with flowers more or less visible; and at their germination, the embryo is almost always protected by integuments, and sprouts upwards, with one or more cotyledons (lobes). Cellular plants have no vessels; their organs of reproduction are not double (stamens and pistils); they are propagated by unfecundated seeds called sporules; and at their germination there are no cotyledons. These two branches are connected by the Fuci plants, which are at the same time vascular and cryptogamous.

The vascular plants may be divided into two classes, *dicotyledons* or exogenous plants, which germinate with two or more cotyledons, and grow from within; *monocotyledons*, or endogenous plants, with an embryo furnished with a single cotyledon, the stem of which lignifies from the outside. We place the characteristics of the two classes side by side:—

Dicotyledons.	Monocotyledons.
Radicle of embryo ramose.	Radicle of embryo fibrous.
Cotyledons, two or more opposite each other.	Cotyledons, one, or if more, alternate.
Stem consisting of medulla wood, alburnum, medullary rays, and bark.	Stem without medulla, medullary rays, or bark.
Leaves with nerves not parallel, and anastomose to each other.	Leaves with parallel nerves, (except in the aroidea.)
Parts of flower, generally either five or multiples of five.	Parts of flower, generally three, or multiples of three.
In our climate green plants, shrubs, and trees.	Green plants in our climate.

The dicotyledons (50,000 species) are divided into four classes by De Candolle; these divisions are much less natural, and therefore less certain than the preceding, since their differential characters are borrowed solely from the flower, and not from the general structure of the organs, as in the fundamental branches:

1. *Thalamiflores.*—8000 species. Calyx polysepalous; corolla polypetalous; stamens and pistils inserted on the base of the flower. Ex. Ranunculus, Geranium, Pink.

2. *Caliciflores.*—25,000 species. Calyx monophyllate; petals and stamens inserted upon the calyx; petals free or united; ovary free or united to calyx. Ex. Rose, Heath, Campanula.

3. *Corolliflores.*—10,000 species. Calyx monophyllate; corolla monopetalous; stamens inserted on corolla. Ex. Primrose, Datura.

4. *Monochlamideæ.*—16,000 species. A single envelope, green or coloured. Ex. Plantain, Nettle, Great Nightshade.

Professor Lindley divides the Monocotyledons (12,000 species) in the following manner:—

1. Envelopes of the flower, petaloids. These appear under two forms, sometimes the calyx is green with three sepals, the petaloid corolla has three petals. Ex. Water-Plantain, Flowering-Rush. Sometimes the calyx is petaloid, coloured, and similar to the corolla. Ex. Orchis, Iris, Lily.

2. Flowers in a spadix enveloped by a spathe.

3. Envelope of flower bracteiform. Ex. Wheat, Rye.

The Acotyledons (13,000 species) are divided into two sections,—those provided with leaves, such as Ferns, Seaweed, and Mosses; and those without leaves, as the Lichens and Mushrooms.

Each of the classes above mentioned is divided into families or tribes, most of which are natural, inasmuch as the genera which compose them are related by the affinity of their organs of nutrition and vegetation.

Families are again divided into genera, which, in their turn, are formed of all the species which have mutual relations, such as the rose tribe, the pink family. The species is formed by all those individuals which we may suppose to have originally sprung from a single plant. Linnæus introduced into botany the practice of designating a flower by two words, the name of the genus, and a specific epithet. Thus, the round-leaved Mallow is *Malva rotundifolia*, the hundred-leaved Rose is *Rosa centifolia.*

Botanical Geography.—This branch of science, which originated with Alexander Von Humboldt, has for its object the study of the laws governing the distribution of plants on the surface of the globe. It is intimately connected with the sciences of meteorology and geology, and, of course, it presupposes a knowledge of plants, or at least of their principal genera, and close acquaintance with geography. We shall here restrict ourselves to giving a general idea of the distribution of trees and plants upon the plains and mountains of Europe, from Etna to the Scandinavian Alps.

I. *Distribution of the plants cultivated in the plains of Europe.*—1. *Olive Region* (*Olea Europœa*).—This region comprehends Spain, Sicily, Italy, and the western parts of Greece. Its northern limit may be described by a line which begins at Bayonne, passes through Montmeillan, bends slightly northward on the north of the Adriatic, and terminates near Constantinople Cotton, oranges, figs, rice, maize, and wheat, thrive in this region. The orange-tree does not pass the Pyrenees, but it is found at Hières, near Marseilles, in France. In Italy it is not found north of lat. 44° 30′: on the coast of Genoa and in Greece it does not pass lat. 40°. 2. *Vine Region.*—Its limit bends slightly northward from the mouth of the Loire towards Paris, Bonn, and Dresden, where it reaches its northernmost point. Thence it bends southward to lat. 50°, and terminates on the shores of the Caspian about lat. 45°. The vine will stand severe winters very well; but its fruit will not ripen without the warm summers of western Europe. Hence, contrary to the general rule, it may be cultivated further to the north in the interior of the continent than by the sea. All the European fruit-trees thrive very well in this region. The limit of maize is nearly parallel to that of the vine, one degree more to the south. 3. *Region of Cereals.*—It comprises nearly all central Europe. The mean limit of its cultivation in Scotland is under lat. 58°: on the Scandinavian peninsula it is a little to the north of Drontheim, under lat. 64°. Then in pushing eastward it turns to the south, and terminates in Russia under lat. 59°. All the cereals, wheat, barley, oats, rye, potatoes, and buck-wheat, thrive very well in the whole of this district. In its northern part, barley, oats, rye, flax, and hemp, are chiefly cultivated. Fruit-trees are also planted in this region; but, generally speaking, their northern limit is a little to the south of that above described, and in the interior of the continent it inclines to lat. 55°. 4. *Barren Region.*—It is only in very favoured spots that any of the cereals will grow north of region No. 3. Barley is the hardiest of them, and advances furthest to the north. It is to be found under lat. 70°, in Norwegian Laponia. In Russia it does not get beyond lat. 65°. The radish, cabbage, and pea, still grow around the dwellings of the people who live out of the region of cereals.

II. *Distribution of forest-trees on the plains of Europe.*—The most southern region is characterized by a great number of evergreen trees, such as the cork-tree (Quercus suber), the ilex (Quercus ilex), the rose-laurel (Nerium oleander), the arbutus, the myrtle, the laurel (Laurus nobilis), the pine (Pinus pinea), the Pinus alepensis, the cactus, the dwarf palm (Chamærops humilis), the aloes, the tree heath (Erica arborea), the Spanish broom (Spartium junceum), the wild laurel (Viburnum Tinus). The limit-line of this region on the north passes along the northern slope of the Pyrenees under lat. 44°, then it pushes up into Provence as far as Montmeillan, cuts the northern extremity of the Adriatic, passes down its east coast, and then crosses Greece to Constantinople. 2. *Oak and Chestnut Region.*—Its northern limit passes to the north of Cornwall, enters France at Boulogne, and terminates under lat. 49°, in the neighbourhood of Carlsruhe. The oak (Quercus robur), and the beech (Fagus sylvatica), are the monarchs of the forests of this region. 3. *The Oak Region* extends in Britain as far as Moray Firth, under lat. 58°. In Scandinavia it reaches lat. 66° north of Drontheim, but it falls back on the east coast of Sweden to lat. 61°, then it traverses the 60th degree, entering Russia at St. Petersburg, and terminates in the interior of European Russia about lat. 59°. The elm, lime, birch, pine, fir, and beech, characterize this region: the last tree does not grow further north in Britain than Edinburgh; but in Scandinavia it advances to the north of Christiana, crosses Sweden north of Lake Wettern, cuts the German coast at Konigsberg, turns to the south, and is finally stopped by the Caspian in lat. 43°. The northern limit of this tree varies in point of latitude more than that of any other—no less than 17°, in 35° of longitude. 4. *The Birch Region* is bounded on the north by a line which passes to the north of Iceland, advances in Scandinavia to lat. 70° 40′, falls back on moving eastward, and terminates near Obi, lat. 67°. The dwarf birch (Betula nana), the larch (Larix europæa), the fir, and the sylvan pine, inhabit this region. The last mentioned tree is found in the north of Scotland, arrives at lat. 70° in Scandinavia, but in the interior of Russia it does not get beyond lat. 65°.

III. *Distribution of plants on the mountains of Europe.*—It is well known that as we ascend towards the summit of a mountain the temperature falls, and we may pass through a succession of climates growing gradually colder, just as if we had bent our steps to the pole from the foot of the same mountain. Hence we see the vegetation on such a hill partaking of the successive characters of the climates. Thus on the Appennines, at the height of 1300 feet, we may see trees which are characteristic of the southern region of plains. The olive thrives very well as high as 1650 feet; then comes the oak and chestnut region, the trees of which shadow the slope between the heights of 1300 and 3300 feet, and here also the vine ceases to be cultivated. The next zone (between 3300 and 6300 feet) corresponds with the region of the beech, which is found in company with the pine, the sylvan pine, the yew, and the hazel. The limit of the cereals is in this zone at a height of about 4600 feet. Beyond this limit only alpine and polar plants are found on the Appennines; but these mountains do not reach the limit of perpetual snow.

Upon the Swiss Alps (mean lat. 46°) the inferior region is principally characterized on the southern slopes by the cultivation of the vine, and the growth of the chestnut tree, which reaches an elevation of about 2600 feet. Above we find forests of beeches and oaks, which cease at an elevation of about 4300 feet on the northern side, but reach about 6250 feet on the southern. The limit of cultivated land is a question complicated with matters independent of climate. Above the last mentioned zone succeeds that of the evergreen trees, which on the south reach a height of 6600 feet, but on the north do not pass that of 6000 feet. Beyond the region of pines and firs only a species of alder (Alnus vividis), some herbaceous sallows, the rhododendron, and some alpine plants, such as saxifrage, are found. The snow line is at a height of about 8900 feet.

In the Scandinavian Alps, under the 60th degree of latitude, the pines and firs reach a height of 2600 feet, the birch rises 650 feet higher, the dwarf birch succeeds up to the line of snow, which may there be placed between 4950 and 5280 feet. Under the 67th degree, in the same country, the pines and firs stop at an elevation of 1050 feet, the birch attains a height of 1650 feet, and the alpine plants occupy the remaining slope up to the snow line, which is as low as 3640 feet above the sea's level.

At Spitzbergen, between 77° and 80°, we only find two sallows, so small that they are almost lost amongst the tufts of moss and herbaceous plants, many of which are similar to those inhabiting the continental Alps. It only remains for us to add, that a student of Linnæus' system, will find Hooker's "Flora," or Macgillivray's edition of "Withering's Botany," a useful assistant. The natural system cannot be better studied than in Professor Lindley's "Vegetable Kingdom, or the Structure, Classification, and Uses of Plants, Illustrated on the Natural System." Professor Lindley is also the author of two other valuable works, "Elements of Botany, Structural and Physiological," 5th edition, and "School Botany, or the Rudiments of Botanical Science." Paxton's "Botanical Dictionary, comprising the Names, History, and Culture of all Plants known in Britain, with a full Explanation of Technical Terms," is also a very useful work.

THE ROOF QUESTION.

The question proposed by our correspondent, R. S., at page 259 of our last volume, on the equilibrium of the framework of a roof figured by himself, has given rise to some discussion, as we find from the number of letters we have received on the subject. Our object in introducing such questions is thus partially attained. A general principle, stated in plain terms, may be inculcated many times before it procures that attention, or produces that conviction, which is necessary for well-grounding the mind in the principles of mechanics, or in those of any other science; when, however, the subject is presented under a new aspect, or in a tangible form, the probability is, that the attention of at least a few is once more turned towards it.

Our correspondence on the roof-question affords an example in point; and it further illustrates the necessity for a familiar acquaintance with general principles, for enabling one to judge summarily and correctly of the particular cases in which those principles are involved.

Were we to undertake a discussion of the general principles implied in the construction of framework, whether as applied to roofs, or as applied to other subjects, we would render ourselves liable to the common charge of having merely repeated what has often been better said by others; nor is it our object at present to do more than briefly to recapitulate some of the elementary doctrines of pressure, and to apply the excellent method of the parallelogram of forces to the style of roof under discussion.

Let A B and A C, fig. 1, be two inflexible bars connected at A, and indefinitely extended and supported towards B and C; let them be inclined towards each other, forming equal angles with the line of gravity, A D, and let D be a given load freely suspended from the point of junction, A. What, then, is the thrust or pressure in the directions, A B and A C? It is plain that the strain in these directions, occasioned by the same weight, will vary with the angles which they form with the vertical line. Should they be almost horizontal, forming nearly right angles with the vertical, the longitudinal pressure is very great, and is equal to many times the load itself; should they be almost vertical, forming very small angles with the line of gravity, the longitudinal pressure in each line is very little greater than the simple half of the load. These general statements must be at once admitted; and, to give precision to the principle involved, a simple diagram is all that is necessary. In masonry or mechanical forces it is convenient to represent them by lines drawn in the direction in which they act. The *length* of the line is optional for any one force; but that being decided upon for one force, the lengths to represent other forces in connection and co-existent with it, must be deduced directly with reference to the assumed length. Thus, the load, D, fig. 2, being represented by the line, A *d*, a convenient length in the direction of gravity, the strains in the directions, A B, A C, will be indicated by proportional lengths in these directions by the application of the parallelogram of forces. Draw *d b*, *d c*, respectively parallel to the inclined bars; the lines, A *b*, A *c*, so defined, represent the strains or pressures on the bars, being the pressures consequent upon the application of the load, D, and counteracted by the surfaces of support, B, C.

Fig. 1.

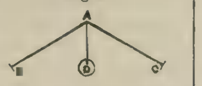
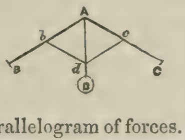
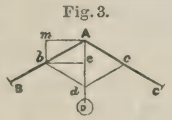


Fig. 2.



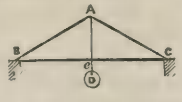
It is plain that the resisting surfaces, B C, to operate effectively, must be at right angles to the direction of the bars. In construction, this is usually an inadmissible case—the case of two simple inclined bars or beams carrying a load, and merely propped up by the points of support. For, to speak generally, there is a horizontal thrust, or tendency outwards, which must be resisted by the props, as well as the merely vertical load; and, once more, the parallelogram may be employed to separate accurately the different forces. Let A *b*, fig. 3, be the strain, as before, in the bar, A B; construct the rectangle, *m e*, in which A *m*, A *e*, are respectively horizontal and vertical; then A *m* represents the horizontal thrust, tending, when communicated to the prop at B, to overturn it, and A *e* is the vertical pressure at A on the beam, A B, and supported also by the prop at B; A *e* is, in short, half the whole load, A *d*. A similar parallelogram constructed on the line, A *c*, would indicate an equal horizontal thrust and vertical load on the beam, A C; and the result of this investigation is, that half the whole load at A is borne by each of the beams, A B, A C, and that each communicates a horizontal pressure to the props, B, C, which obviously must vary according to the pitch of the beams.

Fig. 3.



To neutralize the horizontal thrust thus indicated, so as to leave nothing but the vertical pressure, or the load, to be sustained by the props, the beams must be so bound together as to be rendered a rigid self-contained frame, incapable of altering its form under a vertical load. This is simply accomplished by the introduction of a horizontal beam, B C, fig. 4, fastened to the extremities of the inclined beams; and it will prevent confusion, if, as may justly be done, we adopt the vertical A *e* to represent the half-load sustained by A B. By reference to the corresponding triangles in fig. 3, it will be apparent that, A *e* being the load, it is resolvable into the two pressures, A B, B *e*, the longitudinal thrust in A B being represented by its own length, and the horizontal tension in B C by half its own length. And, in general, the half-load being represented by the rise or pitch of the beams, the longitudinal thrust in the beams is expressed by their length, and the horizontal tension on the tie-beam by its half-length.

Fig. 4.



The "couple," fig. 4, may be varied in form; fig. 5, for example, represents the tie-beam in two parts, elevated at the centre by the amount *e' e*. The parallelogram formed on the beam A B shows, by similar triangles, without need of further explanation, that A *e* representing the load D, A B and B *e* are, as before, the strains in the beam and the tie. It is necessary to remark, that in the case of an elevated tie-beam, a king-post, A *e*, must be introduced to preserve its form. And here our friend R. S. loses himself in a subsequent communication he has made to us on the subject. He supposes that, besides the strains on the beam A B and tie B *e*, allowed for in the triangle A B *e*, there are caused additional strains on them, due to the tension on the bar A *e*, required for sustaining the point *e*. This tension, he finds, is represented by *e' e*, and he decomposes it to show the additional strains it produces on A B and B *e*. To correct this aberration, let A B, A C, fig. 6, be a couple, of indefinite lengths. Let *b c* be a horizontal tie introduced, then A *e* representing the half-load, A *b* and *b e* represent the relative strains. Should, however, the tie-beam be bent at *e*, and attached to the couple at *m n*, the condition of the strains will be very much altered. While A *e* still represents the half-load, the relative strains are now represented by A *m*, *m e*. Here, at once, it is seen that abundant allowance has been made for increased strains in the increased lengths of the couple and tie-beams. It is true, nevertheless, that by drawing *m o n*, the strain *m e* is resolvable into *m o* and *o e*, of which *oe* is equal to the strain on the rod A *e*, exerted to sustain the tie-rods in their form, and *m o* is the horizontal strain on the tie-rod. It is also true, however,—and here it is that R. S. stops short—that A *m* is resolvable into *o m* and A *o*. We have thus four forces to dispose of—namely, *m o*, *o m*, *o e*, A *o*. Of these four, the two first neutralize each other, and amount to nothing; the last force, A *o*, is divisible into two parts, A *e*, *e o*, of which *e o* neutralizes *o e*, the third in order; and A *e* is the sole remainder to represent the final resultant of the forces A *m*, *m e*, constituting together the three sides of the original triangle. This is very like reasoning in a circle; it is, however, useful to show that the parallelogram, though a very admirable means of investigation, may easily be employed to bamboozle, as well as to instruct. We may add, that the load D, may very well be conceived to be suspended by the point *e*, in place of A, in which case there is no plausible ground for assuming an extra strain, such as R. S. presumes to exist.

Fig. 5.

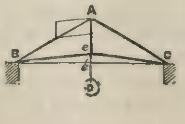
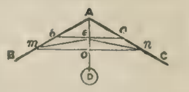


Fig. 6.



To estimate correctly the strains to which the different members of a roof, constructed similarly to the foregoing diagrams, are liable, it must be considered that the load of a roof is equally distributed on the couples, and that the weight on each couple-leg may be viewed as centred in one load on the middle of its length. This would, of course, be an incorrect mode of estimation, were the *transverse* strains on the couple-leg contemplated; but for the longitudinal strains—and it is these we are now considering—the view is correct. One-half of the load is, therefore, directly borne by the prop; and there remains only the other half, the weight of which is transmitted through the upper end of the leg, to be provided for by the framework of the couple. Therefore, the whole load at A, in an ordinary roof, is just half of the whole weight to be sustained by the walls, and each couple-leg sustains one-half of that load, or one-fourth of the whole weight.

With the foregoing general remarks, we trust our correspondents will feel themselves satisfied. Should any further doubts occur to any of our readers, we shall be glad to attend to them.

LIGHT-HOUSE ON THE MINOT'S ROCKS, BOSTON HARBOUR, MASSACHUSSETTS.*

Minot's Rocks, or, as they are generally designated, "the Minots," lie off the south-eastern *chop* of Boston bay, about seventeen miles from the city, and something less than eight miles from the Boston light.

These rocks or ledges, with others in their immediate vicinity, are known as the "Cohasset Rocks," and have been the terror of mariners for a long period of years; they have been, probably, the cause of a greater number of wrecks than any other reefs or ledges upon the coast, lying, as they do, at the very entrance to the second city of the United States in point of tonnage, and, consequently, where vessels are continually passing and repassing. The Minots are sunken, and bare only at one quarter flood, and the trend of the coast in that direction from Boston bay being south-easterly, vessels bound in, with the wind heavy at north-east, are liable, if they fall to leeward of Boston light, to be driven upon these rocks. As evidence of the great necessity of a light at these dangerous rocks, I have in my possession, from a reliable source, a statement of the number of vessels, with their names and tonnage, which have struck upon the Cohasset rocks within the last thirty years, but mostly, as my informant remarks, within the last fifteen years, to wit: ships, 10; brigs, 14; schooners, 16; sloops, 3; total 43. Of these, 27 were a total loss. From all this, it may be clearly inferred that it became necessary that these hidden dangers should be pointed out to the seaman, and, instead of the fatal breaker to give him the first warning of his approach to danger, that there should be a friendly beacon erected upon the rock, to guide him in the storm, and enable him to avoid the horrors of shipwreck; and these, doubtless, were the considerations which led to the enactment of the law for building the lighthouse in question.

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* From the Report of Col. Abert, published in the Franklin Journal.

The rock selected for the site of the lighthouse is called the "Outer Minot," and lies farther seaward than others in the group known as the Cohasset rocks. At extreme low water, an area of about thirty feet in diameter is exposed, and the highest point in the rock is about three and a half feet above the line of low water. It is very rare, however, that a surface greater than twenty-five feet in diameter is left bare by the sea. The rock is granite, with vertical seams of trap rising through it.

From observations upon the tides, made at Boston lighthouse by the coast survey, from June 7th, to October 27th, 1847, the following results were obtained, and, by the kind permission of the superintendent, communicated to me, together with a tracing of the coast from Boston light to Scituate light:—

Rise of highest tide,................................	14 feet 7 inches.
Mean rise and fall of tides,................	9 " 4 "
" " " spring tides,.	10 " 8 "
" " " neap "	8 " 3 "

The form of the lighthouse frame is an octagon, of twenty-five feet diameter at base. The structure is formed of eight heavy wrought-iron piles or shafts, placed at equal distances from each other, with one also at the centre. These piles were forged in two pieces each, and are connected together by very stout cast-iron or gun-metal sockets, the interior of which is bored, and the pile ends are turned and secured to the sockets by means of large steel keys passing through the piles and the sockets. Above and below the joints or sockets, and connecting the middle pile with each outer pile, there extends a series of wrought-iron braces; and the outer shafts are connected together by similar braces, extending from one to the other, and thus the whole structure is tied together. At each of the angular points in the octagon, and at the centre, a hole of twelve inches in diameter and five feet in depth, is drilled in the rock; the outer holes with the inclination or batter given to the outer piles, and the middle hole vertical.

The surface of the rock being irregular in shape, and the holes in each case five feet deep, it is evident that the piles must be of unequal lengths. The least length in the lower series is thirty-five and a quarter feet; the greatest is thirty-eight and three-quarters feet, and the others are of various lengths between them. The piles in the upper series are of uniform length, viz., twenty-five feet each; the inclination or batter of the piles towards the centre, is such as to bring the heads of the upper piles within the periphery of a circle of fourteen feet diameter, and there, at an elevation of sixty feet above the base of the middle pile, or fifty-five feet above the highest point of the rock, the pile heads are secured to a heavy casting or cap, to the arms of which they are securely keyed and bolted. The middle shaft is eight inches in diameter at foot, and six inches at top, and the outer shafts are eight inches at foot, and four and a half inches at top. All of these are forged ten inches in diameter at the point where they leave the surface of the rock, and taper uniformly down to eight inches diameter in both directions, within a distance of five feet. The lower braces, placed nineteen feet above the rock, are three and a half inches in diameter; the second series, nineteen and a half feet above the first, or thirty-eight and a half feet above the rock, are three inches diameter, and a third series, introduced eight and a quarter feet below the cast-iron cap, to form the support of the floor of the store-room, is made of two and a half inch square iron.

The outer piles being inclined towards the centre, and the piles and the braces being inflexible, it is clear that, so long as the braces remain in place, the pile cannot be withdrawn from the hole, for the whole structure acts as an immense "luvis;" either the braces must be ruptured, or the rock itself must yield, before a pile can be displaced.

Upon the pile-heads are cast-iron sockets, furnished with arms three feet in length, pointing outwards. These sockets are keyed to the heads of the piles, and are bolted to the arms of the cap or spider, flush with its upper surface; thus giving a diameter at top of twenty feet from out to out. The object of the arms is to afford support for a footway or gallery outside of the keeper's house, which is placed immediately on the cap, and there secured by bolts and keys.

The keeper's house is octagonal in shape, and fourteen feet in diameter; the uprights or stanchions are of cast-iron, and rest upon the cap immediately over the pile-heads, where they are secured with bolts and keys; these uprights are cast with double flanches, between which two-inch plank, tongued and grooved, are to be fitted horizontally, and at right angles to these another series of plank is to be set on end or vertically, and, together, these form the side or frame of the house; upon this frame the roof will be placed, and, finally, upon this the lantern will be set up.

The drilling of the holes in the rock for the lighthouse occupied the better part of two seasons. The erection of the iron structure in place, it may be conceived, was comparatively a work of much less difficulty, and, with favourable weather, an undertaking requiring not much time. That some of the difficulties may be known of working down nine holes of twelve inches diameter, and five feet in depth, in a rock of granite traversed by veins of the most obstinate trap, in a situation exposed to the delays produced by every breeze which had *east* in it, I will enumerate briefly, from the journal of operations kept at the rock, some of the details, for future reference.

Early in April, 1847, I invited Mr. Benjamin Pomeroy, the contractor, who had in 1843 erected for me the Black Rock beacon, in Long Island sound, (a structure built upon the same principle that the Minot Rock light is built upon,) to accompany me to Cohasset, with the view of inducing him to undertake the drilling of the holes by contract, and also to take the piles, braces, and cap, at Messrs. Alger & Co's., South Boston, where the work was to be executed, and to erect them in place at the Minot. After waiting eight days at Cohasset for a favourable opportunity to examine the rock, we effected a landing, and, with the advantages of a smooth sea and a very low tide, made sufficient measurements to determine the probable area of sound rock which might be relied upon for the base of the proposed lighthouse.

The proposition made by Mr. Pomeroy, to drill the holes in the rock for the reception of the piles for the lighthouse, I considered too high, and consequently I declined it, and sought elsewhere for a competent individual to undertake the work. After advertising in the newspapers, I received proposals from Mr. James Savage, and entered into an agreement with him to drill the holes, but after some weeks' delay, Mr. Savage abandoned the contract; I then recommended, and was authorized to accept, the proposals of Mr. Pomeroy, and he undertook the work at once, but by the failure of the first contractor, the greater part of the best portion of the season 1847 was lost, and it was not until July 22, that the new contractor, Mr. Pomeroy, actually commenced work upon the rock.

The mode of working the holes down had for some time occupied the thoughts of the contractor, and he became satisfied that holes of the magnitude required in that exposed situation, where the sea was so continually breaking over the rock, could be drilled by machinery only, and that it would be necessary to have that machinery elevated beyond the ordinary reach of the sea.

The drill used was of a peculiar form, with an edge in shape somewhat similar to the letter Z, made of the best cast steel, and fitted to an iron shaft some thirty feet in length, and weighing, with the drill attached, about 600 pounds.

The machine for working the drill was a wheel and axle, furnished with tooth and pinion, and a crank or windlass at each end; this was placed on a frame of stout oak, and it required the power of four men to work it effectively. A cam and a fly-wheel were attached to the axle, and at every revolution the drill was raised about eight inches, and driven ordinarily at the rate of about fifty strokes per minute, the men being relieved every twenty minutes.

To support this machine, it was necessary to erect upon the rock a triangle or shears of very heavy spars, secured at their feet by means of pintles, and chained down to Lewis bolts inserted in the rock; upon the triangle was placed a platform, and upon this the machine was worked, the drill being kept at the proper degree of inclination for the hole by means of guides, through which the shaft moved up and down. The whole arrangement answered the purpose admirably well, and the holes were cut as truly and as perfectly as an auger hole could be cut in a piece of wood.

The triangle and drilling machine were swept from the rock twice by the sea during the first season's operations, and the men were frequently washed from the rock, but happily no lives have been lost. The work was suspended at the rock on the 25th October, 1847, and by reference to the journal of operations, noted carefully day by day, it will be seen how short a space of time can be reckoned upon for work in a situation so exposed.

In the report of the contractor of the 8th November, 1847, accompanying the journal of operations for that season, is the following remark:—

"It will be seen by my journal, that from the 22d July to the 25th October, I was able to land on the rock, to do work, only 25 days, viz., 5 days in July, 13 in August, 7 in September, and none in October. The whole number of hours we did actually work on the rock was only 120 hours, of which 53 were from the triangle, when we could not stand on the rock to work."

The total number of men employed in 1847 by the contractor was 34, the average number about 21; in addition, a schooner of about 80 tons burthen was chartered by the contractor, for himself and his hands to live on board of, and the vessel was kept moored near the rock at all times when she could lie there in safety, or when the weather would admit of it; by this arrangement every hour of time, in which work could be done at the rock, was rendered available.

All the necessary preparations for the work of the present season were made early in the spring; a new triangle was provided of heavy spars, some forty-five feet in length, and strengthened by a number of very stout iron braces, and with bars of iron on each spar, extending over all that part of the triangle which was exposed to the shock of the sea; a vessel and hands were employed by the contractor, but no work upon the rock was effected until the 18th, 19th, and 20th May, and from that period until the 3d and 5th of June nothing was done, the weather and sea preventing even a landing. Between the 14th and 29th of June, the sea generally was smoother, still there were several of the intervening days on which little or nothing could be done; from 29th June to 19th July, but three landings were made, and at these times the sea ran so high there was but little work accomplished.

On the 21st July, this remark is found in the journal: "To-day and yesterday worth more for work on rock than last four weeks."

The holes were all finished on the 16th August; that is to say, nine holes of twelve inches diameter, and five feet deep each.

Some delay was produced in this stage of the work, by an alteration which I had decided some time earlier in the season to make, to wit: to increase both the size and the length of the lower series of piles, and this increase in dimensions produced some delay in the forging at the machine shop. The difference in size between piles of hammered iron twenty-five feet long, and eight inches diameter, as originally designed, and piles thirty-five feet long, and increased to ten inches diameter, the size ultimately adopted, involved some difficulties, and required a little more time in the fabrication than I had reckoned upon, so that it was not until the 2d September, that six piles of the lower series were forged.

On the 4th and 5th September, these six piles were erected in place, and, by the 21st, the three remaining lower piles had been placed, and three of the braces belonging to that series placed also.

From the 21st September until the 7th October, no landing could be effected upon the rock. On that day, the middle pile of the upper series was placed in its position; on the 10th October, two more were put up; on the 12th, five more; and on the 16th, the last pile of the upper series was set in its place. On the 26th October, the cap or spider, a casting to rest upon the heads of the piles, to receive the dwelling-house of the keeper and the lantern, consisting of eight arms, and weighing some five tons, was hoisted partially towards its place; and, on the 30th October, this difficult undertaking was successfully completed, and the spider fixed in its proper position and secured there, at an elevation of fifty-five feet above the top of the rock.

The Boston light being a revolving light, the Minot, being next in order upon the coast, should be a fixed light; accordingly the apparatus ordered is of that character, and is composed of fifteen brass lamps, with reflectors of twenty-one inches diameter in the clear, with very heavy plating of silver, and of the best description of work.

The framing of the lantern is of wrought-iron, and is a polygon of sixteen faces; diameter at the angles, eleven feet six inches; height, six feet six inches, furnished with cast-iron ventilator; the glass, French plate, forty-four inches by twenty-four inches, and three-eighths of an inch thick; the extent of the illumination will be two hundred and ten degrees.

Thus it will be seen that the entire height of the structure, from the surface of the rock to the top of the lantern, will be about seventy feet, and upwards of fifty feet above the line of highest water.

The weight of iron work in the shafts, braces, couplings, collars, spider or cap, and columns for keeper's house, is nearly seventy tons; of this, upwards of forty tons is wrought-iron, and the residue of cast-iron; the average weight of each complete shaft is about 8,200 pounds; the cast-iron couplings for connecting the upper shafts with the lower are three feet long, and weigh nearly 800 pounds each; they are made of the best gun-metal. The weight of the lantern and illuminating apparatus will be about four and a half tons. The lantern, lamps, reflectors, and other fixtures for the lighthouse, will cost four thousand five hundred dollars, as will appear by the detailed estimates of same, rendered on the 24th ultimo.

Below the keeper's house, and enclosed within the pile-heads, a species of cellar or store-room, of the size of the house, is to be built, to contain oil, fuel, provisions, &c. I had hoped last season, that all this might have been accomplished before the boisterous weather of the present year came on, and the light brought into use this winter; but this has not been practicable, as the journal of operations will clearly prove.

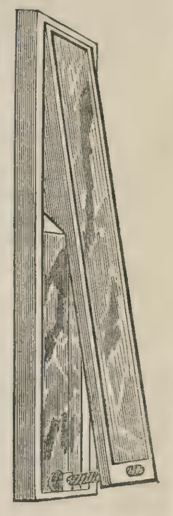
On the other hand, it may be considered not unwise to allow the skeleton structure to stand through one winter exposed to the fury of the sea, before the lighthouse is fitted up with its illuminating apparatus, and before it is occupied by a keeper.

Very respectfully, sir, your obedient servant,

W. H. Swift,
Captain, Topographical Engineers.

Col. J. J. Abert, Chief, Topographical Engineers.

DIXON'S VENTILATOR.



We have frequently had occasion to notice the unsightly appearance of all the ordinary window ventilators. From the old-fashioned tin whirligig, to the modern plate-glass "louvred" opening, there are only so many grades of ugliness; and, without entering upon the vexed question of draughts, unwelcome visitations of rain and snow, with other unpleasant qualities belonging to many schemes of this nature, we feel convinced that a better appearance would alone insure a welcome to any new invention. All these good qualities are claimed by its projector for the ventilator we now engrave. It is the invention of Mr. William Dixon, of 19 Williamson Square, Liverpool, and has been registered under the act for the protection of articles of utility. It may be described in a few words, as a pane of glass hinged at the top, and moving outwards at the bottom—in fact, a hanging valve—the opening and shutting being regulated to the greatest nicety by a quick-threaded screw. A cord passes round the head of the screw, and the ends hang down, one on each side of the window. By pulling one tassel, the screw turns round and opens the ventilator, and when the cord is pulled back by the other tassel, the motion of the screw is reversed, and the pane is closed. An inside *half* pane directs the cold air upwards, and it is thus diffused over the room without creating any unpleasant draught. We have heard of several that have been tried for some time in very exposed situations, and they appear to have given unmixed satisfaction. The peculiar advantages of this ventilator are, its ready application to all kinds of windows, without in any way interfering with direct vision, or the opening or closing of the window; and as it can be constructed for either inside or outside shutters, no situation need be any bar to its use. Its original low price, and the economy of its repairs—for it is made of ordinary window glass, and therefore easily mended by any plumber and glazier—recommend it for general use; and we think, if it were better known, it would be more frequently adopted. D.

TINDAL'S DOMESTIC MANGLE.

This mangle, figured and described by us at page 33 of our May number, as "Oldfield's Domestic Mangle," is the invention of Messrs. E. O. and L. Tindal, of Scarborough, Yorkshire. The error in calling it "Oldfield's," arose from the fact of one of the members of the firm in question possessing the name of Oldfield, in addition to his true surname.

THE MECHANIC'S LIBRARY.

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RECENT PATENTS.

ELECTRO-MAGNETIC ENGINES.—Soren Hjorth, London.

(*Concluded from page* 59.)

Figs. 1, 2, and 3, represent some of the many variations in the form and shape of the magnets, and which may be adopted for the purpose of carrying out my improvements in the use of electro-magnetism. In fig. 1, the coiling of the magnet is surrounded with a sheet-iron casing of a conical form, corresponding with the interior of the magnet, in order to obtain a greater attractive surface, and to make the poles of this magnet more effective. Fig. 2 is an enlarged view of the magnets in fig. 1. In fig. 3, a long stroke and great attractive surface are obtained by placing a spiral-shaped surface in the interior of the magnet, and corresponding grooves or apertures in the magnet. By this arrangement, the magnet will act or exercise an attractive power on the successive points of the spiral-shaped surface before mentioned, in the same manner as the magnet acts on the rods of different lengths placed in the magnet in fig. 1. Fig. 4 represents a horse-shoe magnet, each leg of which is divided into two pieces inclined on the inside, and with grooves inside to receive the wires, which are coiled as shown in fig. 5, the current passing in the direction indicated by the arrows. The magnet is in this case not coiled with wires, being a permanent magnet.

Fig. 1.

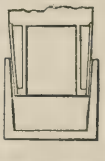


Fig. 2.

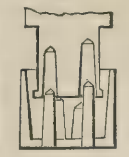


Fig. 3.

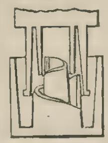


Fig. 4.

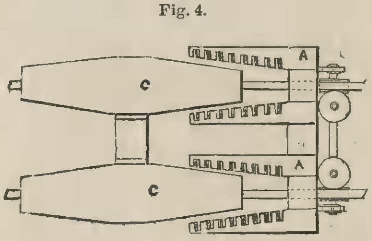
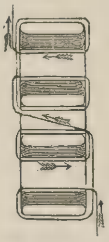


Fig. 5.



The patentee does not confine himself to the use of wrought-iron in the magnets or armatures, which may be made of cast-iron, or other metals or substances, which may be made magnetic. It will also be obvious that the repulsive as well as the attractive powers of metals or other substances, may be rendered available for the same purposes by means of apparatus constructed and arranged in a manner similar to that herein described.

The motive power obtained by the arrangements above described, may be employed for all purposes in which power may be required, by the addition of the ordinary apparatus used for such purposes. Thus, the power may be rendered applicable for raising weights, and especially for raising the ram of a pile-engine or a heavy hammer. In these cases it is intended to apply a magnet, constructed according to this arrangement, immediately over the ram or hammer, connected with it by a wet chain or rope, and moving with it in guides. On the side of the frame or guide, adjusting tappets would be fixed, by means of which the connection with the battery would be cut off at any required portion of stroke.

Figs. 6 and 7 represent an arrangement by which magneto-electricity is produced in an electro-magnetic or common locomotive, for the purpose of magnetising the wheels, and thereby increasing the adhesion; A are horseshoe-formed permanent magnets, placed so that the inside part of their poles face a certain number of pieces of soft metal, or electro-magnets, B, fixed between the spokes of the wheels. As soon as the wheels are set in motion, electricity is induced in the coils surrounding a cylinder of sheet-iron, C, fixed between the wheels. By this arrangement the cylinder, as well as the wheels, will of course be magnetic, and the magnetic power will be increased in proportion to the speed of the wheels, giving thereby an increased adhesion proportionate to the slipping which may take place from want of weight, or any other cause. The electricity produced in this way may also be made available for moving the engine itself by a number of electro-magnets fixed to the wheels of the engine or carriages, and so revolving by the motion of the train, and brought within the action of fixed permanent magnets, the electricity produced being conducted to the electro-magnetic engine as an auxiliary power. By means of arrangements similar to those just described, an auxiliary power for stationary or marine engines may be obtained from the magneto-electricity developed by the revolution of fly-wheels, paddle-wheels, drums, or working wheels.

Fig. 6.

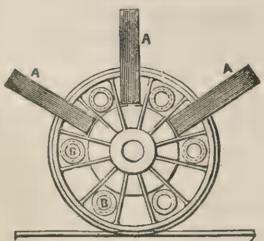
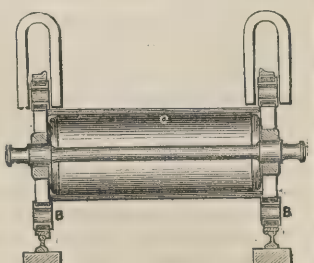


Fig. 7.



The patentee explains and figures another form of commutator or current changer, as applicable either to the oscillating class of engines, similar to that shown in our first notice, or to ordinary reciprocators. To the centre shaft in each set of magnets is attached, at right angles to it, an upright vertical lever, formed with two cross arms, at the end of each of which is placed a syphon cap, similar to those ordinarily used for lubricating purposes. Immediately beneath the discharging tubes of these lubricators, two metallic springs are attached to two pieces of wood, and these springs are adjustable to suit the "lead" required by a set-screw, and serve as conductors from the battery to the magnetic coil. The two levers and springs act for the back and forward movements of the engine, and each spring is so set that the end of the lever is brought into contact with it just before the engine crank reaches its top centre.

By this means the electric current from the battery is conducted from the spring to the levers, and so to the magnetic coil, and the power of the engine is excited for the down stroke on the side in question. A corresponding action takes place in the springs and levers connected with the opposite set of magnets. During the forward motion of the engine, the first spring is kept completely clear of the motion of the lever, by means of a tappet or cam, or any ordinary mechanical arrangement. A corresponding arrangement is adapted to the other spring, and in working the engine, the two tappets or cams may be worked by one handle, so that one spring shall be depressed out of the way, and the other released into action, and thus the motion of the engine be reversed. In order to avoid the spark, and to facilitate the communication of the electric current from the springs to the levers, diluted sulphuric acid is constantly allowed to drop from the syphon cups, through the tubes, by means of a wick to moisten the surface in contact. A similar arrangement being applied on the other side of the engine, and the springs adjusted so that the touching point or surface of the lever on one side of the engine does not leave the corresponding spring before communication is established on the other side of the engine, the same result is obtained as has already been described in the other form of commutator.

Fig. 8 represents a side elevation of an arrangement by which a rotary motion, with a constant and direct pull, and succession of polarities can be obtained, being one of the modes in which this invention can be applied in and for the construction of a rotary engine. A A Are the stationary magnets, here represented as rods of different lengths, put together in such a way that they form a case, with a slit towards the centre for the arms of moveable magnets, B B. The said rods are to be fixed in such a way that they do not touch one another, and their ends or surfaces form angles with the direction of motion of the moveable magnets; these are to be placed at such a distance from one another, and in such a way that one set of magnets commences to exercise its power before the current passing round or through the other is broken, in order that a constant flow of electricity may be maintained without the current from the battery being broken. The change of the current can be produced by a modification of the common arrangement, of a cylinder of metal worked by the shaft, and inlaid with some non-conducting material, from which the conducting wires extend to the coils surrounding the magnets.

Fig. 8.

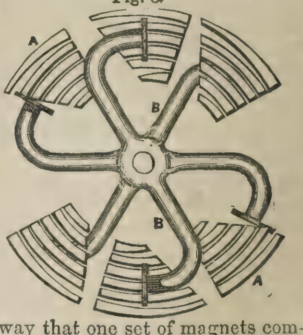
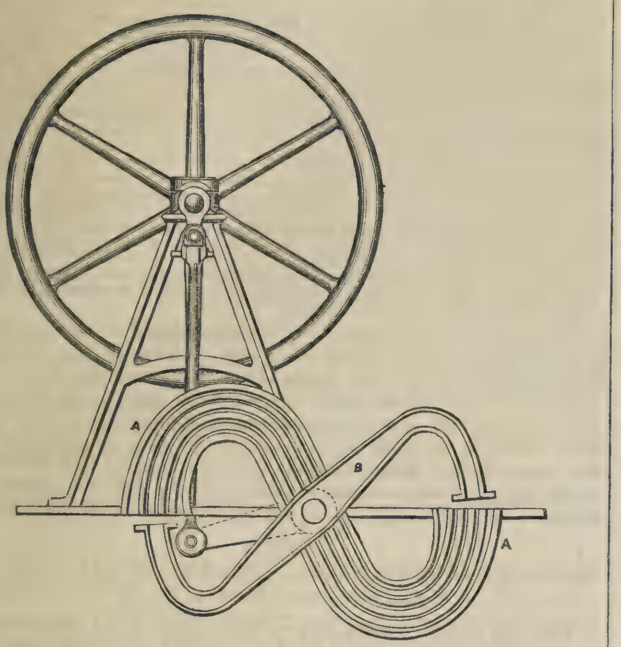


Fig. 9 shows how a semicircular motion, or a reciprocal rotary motion, can be obtained, which may be converted into a rotary motion by cranks. A Is the stationary, and B the moveable magnet. The poles of the stationary magnet form cases, the interior sides of which, or their poles, if built of several bars, form angles with the direction of motion of the moveable magnet. In the said cases may be placed rods of different lengths, with corresponding apertures in the moveable magnet. The current may be broken in the same way as described in the oscillating engine represented in the engraving. Two sets of magnets will be ordinarily required, working in opposite directions.

Fig. 9.



Claims.—*First.*—I claim the constructing, arranging, and combining magnets in such a way that they exercise their attractive or repulsive power mutually, by a continuous and direct attraction or repulsion upon points presenting themselves successively during the whole stroke, in and for the production of motive power by means of electro-magnetism.

Secondly.—I claim the regulating the current of the electric fluid by allowing the same to pass through bodies with surfaces of different dimensions, touching or rubbing upon one another in such a way, that the areas of the said surfaces are diminished or increased by being moved by a governor, thus allowing a greater or smaller supply of the electric fluid to pass, according to circumstances, in and for the production of motive power by means of electro-magnetism.

Thirdly.—I claim the changing the direction of the current by means of a commutator constructed as above described, in the use and application of electro-magnetism as a motive power.

Fourthly.—I claim the use of electro-magnets adapted to and in combination with engines and carriages on railways, as above described, for the purpose of increasing the adhesion of the wheels, and as an auxiliary power for magnets on railways, or stationary and marine engines, as before described.

Fifthly.—I claim the arrangements before referred to for producing a rotary motion by a direct pull or thrust, and continual succession of polarities, as above described.

Sixthly.—I claim the arranging and combining magnets constructed as described, so that a semicircular motion or a reciprocal rotary motion of the moveable magnet may be obtained, and the power transferred thence, either directly to the work, or through cranks and connecting rods to a revolving shaft.

Lastly.—I claim the combining the several arrangements before described and referred to for the application of electricity as a motive power to engines, ships, and railways.

[Some two years ago, we entered upon a series of experiments bearing upon the main identical points here illustrated by Mr. Hjorth, with the view of obtaining a long stroke with little variation of the distance of attraction. Conical magnets were proposed to be applied, but we never actually made them, although designs were made out for the purpose. The most feasible plan, as it then appeared to us, was the adoption of two chains of hollow cylindrical magnets, eight in each chain. These were connected by a spindle running through the axes of each, and fitted with stopping studs, so that, although each separate magnet had a stroke of no more than 1-8th of an inch, yet, as one after another came into play, the whole eight gave a stroke of nearly an inch. We failed in obtaining power; perhaps Mr. Hjorth may be more successful.—Ed. P. M. Journal.]

REGISTERED DESIGNS.

SUTTIE'S IMPROVED KITCHEN BOILER WITH CENTRAL FLUES.

Registered for Mr. Thomas Suttie, 18 *Cathcart Street, Greenock.*

This arrangement has reference to the boilers usually attached to, and forming the backs of, kitchen ranges. It has for its object the acceleration of the process of heating water, and the economy of fuel consumed. It is similar in its general form to ranges of the same class, where the back of the grate is judiciously contrived to form a heating receptacle for water, and which has deservedly come into general use; the only objection attachable to it, being the difficulty of obtaining a *constant* supply of heated water, when large drafts are made upon it for baths, or culinary purposes. This defect has been remedied by Mr. Suttie, by the application to the boilers of one or more central flues, in order to obtain a greater amount of heating surface. Fig. 1, of our engravings, represents a perspective view of the range with the boiler attached; and fig. 2 is a transverse section of the boiler alone, exhibiting the position of one of the flues. A, Is the boiler of the ordinary shape, having a vertical flue, B, cast or formed in its centre, the lower end opening into the back of the grate; by which opening the heated air and flame is taken up, so as to pass through the centre of the body of water contained in the boiler. A similar flue, marked C, is formed near the end of the boiler, to carry up the heat from the oven flue. The upper end of both of these flues is carried up 12 inches above the level of the lintel, so that they produce strong currents far enough above the lintel, to aid the natural draught, and prevent any tendency to smoke.

Fig. 2.

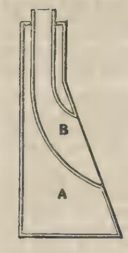
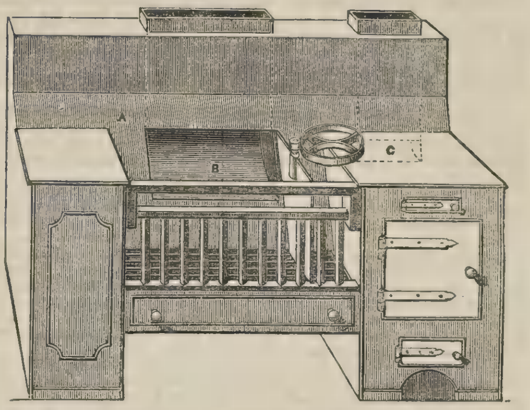


Fig. 1.



The trials already made by the inventor, show that a considerable increase of heating power is attained by this simple modification.

REVIEWS OF NEW BOOKS.

The Marine Steam-Engine. Designed chiefly for the Use of Naval Officers and Engineers. 8vo. pp. 333. Plates and Woodcuts. London: Hebert, Cheapside.

The two gentlemen whose names appear at the foot of the preface of this work as its authors—Professor Main, of the Royal Naval College, Portsmouth, and Mr. Brown, chief engineer, R.N.—are already favourably known to the students of engineering literature, as practical and able professional advisers. We have only to refer to the "Indicator and Dynamometer," issued by them in 1847, for evidence in point, and such evidence as every one can comprehend.

Their present production stands alone in its very serviceable qualities of pointedness, and judicious restriction within the reasonable limits of the subject, as it affects the practical engineer, whose sphere of action is mainly confined to ocean navigation, or the naval commander, who unites, or ought to unite, an acquaintance with his propelling power, with his legitimate craft of sailorship. The book, then, takes no note of the conflicting opinions relating to the many varieties which taste, necessity, or empiricism, has added to the list of marine engines, and their collateral machinery; neither does it rush back into the oft-trodden way of elementary investigation, or supply simple details of construction, showing what has been done, and leaving much to guess at, as to what is wanted; but, taking the system as it now is, it professes to furnish such information as, for the due management of such a system, the engineer and officer require. The volume is divided into nine chapters, the first of which is devoted to a series of short introductory dissertations on the fundamental principles in connection with the power treated of; the second examines the existing varieties of engines with their chief details; the third considers the marine varieties only; the fourth is on boilers; the fifth, on getting up the steam; the sixth, on duties to machinery when under steam; the seventh, the same under action; the eighth, on arriving in harbour; and the ninth embodies a collection of miscellaneous matter, more particularly referring to screw propulsion.

From chapter 5, on getting up the steam, we extract one or two heads, illustrative of the extreme plainness and simplicity of the style of treatment, and the satisfactory nature of the rendered information:—

> "*Safety-Valve.*—It is a common practice to open the safety-valve when getting up the steam: this is not a good plan. The object of doing this evidently is, to allow the air to escape that had been mechanically mixed with the water, and was liberated by the heating process. As this air becomes disengaged, its pressure acts on the surface of the water, and checks ebullition. Hence the safety-valves are commonly opened. But it is more judicious to let the heated air pass through the engines, where it will help to warm them.
>
> "*Throttle-Valve.*—The throttle-valves should be opened shortly after the fires are lighted, to prevent their setting fast, which they will do if kept shut; for the steam and heated air will expand the valve; and when set fast in its place, it will be impossible to get the steam into the cylinder. Cases of this kind have at times happened. Indeed, in one instance, the engineer, while endeavouring to open the valve, was obliged to use such force, that the handle broke off, and effectually prevented the starting of the ship, for that time at least.
>
> "*Lubricators.*—The lubricators ought to be trimmed and filled up before starting; for if not, it cannot be so well done afterwards; it is true, it must still be done afterwards when under weigh; but as this cannot be prevented, the waste consequent upon so doing must be borne with, and must not obviate the rule of carefully seizing the opportunity while stationary.
>
> "*The Moving Parts of the Engine.*—The engineer should look under all the moving parts of the engine, particularly where they come near some fixed part of the ship, to ascertain whether any obstacle intervene; as, for example, while repairing the engine, blocks of wood are interposed to support some of the heavy portions; and these are frequently left afterwards, and become a cause of serious mischief. For instance, a block of wood was placed on the condenser of one of the engines of the Retribution, to support the cross-head, and was not perceived by those in the engine-room. The engine was set in motion by the surge of the sea; and, acting on the T-plate, drove the block of wood down on the upper surface of the condenser, which it split. Where the cylinder-covers are recessed to admit of the piston cross-head working into them, so as to give greater length to the connecting-rod, these hollow spaces must be carefully cleared.
>
> "*Funnel-Stays.*—While getting up the steam, attention should be paid to the funnel-stays. It is a practice in some steam-ships to tighten up the funnel-stays for the sake of appearances; they became slack after the steam has escaped, and the boiler cools down, because all the heated parts, such as the boiler, uptake, funnel, &c., contract as they cool; and the crown of the boiler, which had been, in all likelihood, somewhat forced up by the steam, recovers its shape. We must, therefore, when the fires have been lighted, take the precaution of slacking off the funnel-stays till the steam is up, when they may be tightened again. Now, it will generally happen, that, if the funnel be taunt, and the stays not too much spread, they will require a second setting up; and it is for the following reason. After the steam has been up some time, the heat from the funnel communicates with the stays, being conducted down them; so that they become lengthened, and slack again. If the stays are much spread, the heat is carried off while endeavouring to ascend vertically, and consequently the stay does not expand so much. If no attention is paid to the stays, to slack them off as the top of the boiler rises, and the expansion goes on, either the stay or its fastenings will yield. In one instance, the hoop round the funnel, to which the stays were attached, gave way, and nearly proved fatal to those who were walking on the deck at the time. The bolts in the gunwale have occasionally been drawn, when in a heavy sea, by the want of spread in the stays. The foremost stays are most affected in this way; for, as the ship pitches, the funnel has a tendency to fall aft. To remedy this, the eye-bolts should be driven in at right angles to the direction of the strain. This plan was adopted in H.M.S. Alban, and effectually prevented the disposition, evinced beforehand, of drawing out of the bolts. While speaking of funnel-stays, we may observe, that it is usual, where the funnel is taunt, in gales of wind to put up extra stays midway between the deck and the other stays. These are sometimes called belly-stays, but more properly preventive stays."

Simplicity of language, with precision of direction, may be here said to be carried to an extreme; but this is a pleasing relief from the continued aiming at mathematical aphorisms so frequent in works on subjects similar to this. Under the head of "The number of boilers to be used when not going at full speed," we find some matter of importance:—

> "There is a common practice in our steam navy, when employed on a service in which particular despatch is not the object, to use half the number of boilers, and proceed at a speed proportionably less, in order to consume less fuel in traversing the distance. The saving thus effected depends on the fact, that the consumption of fuel *per hour* varies as the *cube* of the speed, and the consumption of fuel *per mile* depends on the *square* of the speed. Suppose, for instance, a vessel to be furnished with four boilers, and that her speed when using all four is 10 knots, her speed with two boilers would be 8 knots nearly. Let us suppose, for argument sake, each boiler consumed half a ton an hour; then, at full speed, 4 half-tons, or 2 tons, would drive a ship over 10 knots, or 1 ton would propel her over 5 knots. Again, in the second case, 2 half-tons, or 1 ton, would send her over 8 knots. Hence we should, by this method, gain 3 knots in distance for every ton of coal: and we may set it down as a general maxim, that the slower a vessel goes, the greater the distance she will steam over with the same consumption of fuel. This is on the supposition that she meets with no strong head-winds, &c., such as to force her to use all her power. If, however, the wind or tide would have the effect of making her go astern, her rate through the water, for the greatest economy of fuel, should be at least half as great again as she would have gone in the opposite direction if no power had been used. Thus, if a vessel be steaming up a river which flows at the rate of 4 knots, her most economical speed would not be less than 6 knots, making good 2 knots over the ground.
>
> "But it is a question for mature consideration, whether a still further saving might not be effected by a different mode of managing the fires. Suppose, for instance, as we at first had arranged, that the vessel be going at 8 knots, using two boilers instead of four. The alteration we would propose is, that instead of using two boilers she should use three; but that the speed of the ship should still not exceed 8 knots, which she would have had with two boilers. To effect this, the engineer must do all he can to produce a slow combustion; and it is supposed that by this slow combustion a considerable saving would be effected. Those of our readers who are conversant with the mode of producing steam on the Cornish system will be more likely to appreciate this; for our endeavour is to make the two methods approximate, by spreading the fuel over three sets of flues or tubes instead of two, and so allowing more heat-absorbing surface. One of the authors of this work (Mr. Brown) had lately an opportunity of trying this plan for a short time on board H.M.S. Avenger, though not long enough to obtain any measured results. An order had been given to go on with two boilers, and the fires in them were worked in the usual way, and kept in an active state of combustion. Shortly afterwards the order was given to proceed with three boilers, but no additional orders were received to go on faster than with the two. It was then found that it was scarcely possible to cover the fire-bars in all the boilers with fuel, the rapid absorption from the great quantity of surface was so effective in keeping up the steam. The saving of fuel was very great, but the limited time of the trial would not allow the actual quantity to be ascertained. If difficulties should arise, when using large boilers, in obtaining a small supply of steam; that is to say, if it be found that when all the fire-bars are covered too much is generated, let one or more fires in each boiler be put out, and their ash-pit doors closed, so as not to allow the cool air to enter. And in using the boilers in this way the ashes may be repeatedly burned over again, merely throwing the clinkers away."

The pages are thickly strewn with well-executed woodcuts, which appear to fulfil their explanatory intentions much better than the two perspective plates. The latter appear to have been hurriedly drawn, whilst the engraver has evidently not bestowed much care in transferring them to the copper. When we find time to penetrate further into its pages, we shall return to the work for more information as to its qualifications for the engine-room. Meanwhile, our previous remarks will show that it carries with it a large amount of that peculiarly available species of instruction which the engineer too often cannot find in the hour of need.

Weale's Papers on Engineering. Part XII. May 14, 1849. Plates and Woodcuts. London: Weale.

This part of Mr. Weale's very valuable series is no exception to the general rule of excellence which has pervaded its predecessors. The volume, of which this forms a part, contains seven original papers:—On the application of water power—the introduction of steam-engines into naval arsenals—on harbour works—on the Cornish pumping engine—and on water wheels—with a translation from the French of MM. Gouin and Le Chatelier, on experiments on locomotives; and of these, the five last are in the part before us. They form a very attractive bill of fare, albeit Sir Samuel Bentham's ancient engineering practice, as far as it is here illustrated—being only to the extent of twenty-three pages—presents but little allurement.

Mr. Pole's paper, "On an Analytical Investigation of the Action of the Cornish Pumping Engine," forms the third part of "A Treatise on the Cornish Engine," the two first of which were published in 1844, as "Appendix G to Tredgold on the Steam-Engine." With one extract from the author's remarks on the importance of considering the boiler apart from the engine, we may leave the treatise for the perusal of those who have felt satisfied with the two initiatory portions:—

> "We have brought the investigation into such a form as to express the duty in reference to the weight of *water* used, because here, properly speaking, the consideration of the *engine* ends. When the duty of the *coal* is calculated, another element must be introduced, which ought always to be kept distinct, and to be treated of separately—namely, the evaporative power of the *boiler*. It is customary, in the Cornish reports, to give the duty per bushel of coal, and generally, for other engines, the number of lbs. of fuel used per horse power per hour; and this method may answer very well for the purpose it has in view, viz., to give an idea of the economy of the *whole machine*, or the relation between the two extremes of work done and fuel consumed. The unscientific proprietor of an engine cares very little for any other information than this: if one engine does more work than another with the same quantity of fuel, it matters not to him whether the advantage lie in the engine or the boiler,—in the production of steam, or in the manner of using it. But with the engineer, or the person who seeks to understand the cause of the greater economy, the case is different; for before he can advance far into the investigation, he must know what proportionate part each of the two great elements of the machine takes in the production of the ultimate effect;—he must ascertain first how much steam is generated by a certain amount of fuel, and then how much work is done by a certain quantity of steam: the former will show him the economy of the boiler, the latter that of the engine.
>
> "Take a case nearly analogous, viz. that of a manufactured article supplied for general use. The public are only interested with the ultimate cost of the article, without considering the divisions of its course of production. But the economist will take care to ascertain, first, the cost of the raw material as supplied to the manufacturer, and secondly, that of the manufacturing process itself. It is evident that a reduction in either of these affects the consumer in the same manner, viz. by a reduction of the cost of his purchase; but to those who would study the economy of manufacture, it is essential to know at what point of the process the difference arises. So with the steam-engine. The *boiler* furnishes a certain quantity of the raw material—steam, at a certain cost of fuel. The *engine* works up, so to speak, a certain quantity of this material into a certain amount of power. An improvement in either of these processes affects the owner in the same manner, viz. by a reduction in the cost of his work done; and the expense of the duty or horse-power, in terms of the coal used, furnishes him with this element: but the engineer must know, as the first step towards any satisfactory explanation of the fact, whether the reduction has taken place in the first process or the second.
>
> "The consideration here urged has been too much neglected heretofore, and hence our limited knowledge of the precise nature and operation of many of the elements which enter into the economy of the steam-engine, most particularly as to the generation of the steam. The ignorance of engineers as to the nature of the circumstances which influence the working of the prime organ of the steam-engine, the boiler, and their inability to define,

à priori, what are those best adapted to secure economy in the production of steam, are become almost proverbial, and afford no complimentary idea to unprofessional men of our powers of ratiocination. And yet this is to be charged in a great measure to the want of data of the kind we have named. It is to be hoped, however, that as science is advancing, and as our processes of investigation become more perfect and complete, our knowledge on these points will soon become worthy of the high position occupied by English engineers.

"The plan of separating the consideration of the boiler from that of the engine was long ago adopted by Smeaton and Watt, and has since been followed by a few others. The course of our analysis naturally leads us to pursue the same method, and it should be strongly recommended to all those whose task it may be to conduct investigations, either of a theoretical or practical nature, into the working of steam-engines. Let it be remembered that every statement of the quantity of work done, compared with that of the fuel consumed, is immeasurably enhanced in value if there be added to it a definite and correct account, derived from actual trial, of the proportionate quantity of water evaporated and used in the shape of steam by the engine. Without such addition it is impossible to deduce any results, worthy the name, from the consideration of the working of the machine."

The last paper is that by Mr. Fairbairn, "On Water-Wheels with Ventilated Buckets." It is illustrated by well-executed plates of the author's water-wheel with ventilated buckets, without sole-plate, together with one with a sole-plate, as erected for Mr. Ainsworth, at Flosh, near Whitehaven, and a sectional ground plan of the well-known Catrine water-wheels. As a practical paper, Mr. Fairbairn's name is sufficient to recommend it; as a detail of historical facts, we are doubtful if it does not err in its assignation of the date of construction, together with the merit of conception, of the ventilating water-wheel, the earliest example being, as far as we are aware, that at Egerton, in Lancashire, constructed by Mr. Bodmer, then of Bolton.

We are sorry to learn, although Mr. Weale does not himself announce the fact, that this is the last of his "Papers on Engineering."

Alteration of Railway Guage: a Letter addressed, by permission, to his Grace the Duke of Buccleuch, by John Sewell. Edinburgh: Grant and Sons, 1849.

Mr. Sewell, in his official capacity on the Great Western Railway, has had the best opportunity for investigating the merits of the broad or seven feet guage; and his pamphlet is certainly all that could be wished as a piece of special pleading, *ex parte*, the Great Western line. His intention is to illustrate the practicability and advantage of extending the broad guage from London throughout the country to Scotland, and in thus widening the present 4 ft. 8½ in. guage, he expects, by keeping the frames of carriages and waggons entirely within the wheels, to keep them yet clear of bridges and tunnels. We happen to know, however, that, on many of the existing narrow guage lines, there is now just sufficient clearance and no more; and if any widening takes place, it will involve very much more alteration than he appears to contemplate, and that of the most expensive kind.

We all know that the narrow guage is *too* narrow, but then we are also acquainted with another little fact, *per contra*, that the wide guage is too wide. Whilst stability of movement at high speeds, in addition to a convenient space for the engine, is the great point in railway construction, we do not see that anything is to be gained by adopting a guage so wide as seven feet, accompanied as it is, and must be, by so many countervailing disadvantages of expense, and inconvenient expansion of parts. Why, when it is pretty nearly a universal opinion, that a medium guage of six feet is the best, should not our author propose to reduce or expand all lines to this standard? If we are to alter at all, let us have a six feet guage, but save us from anything wider.

CORRESPONDENCE.

THE RESISTANCE TO RAILWAY TRAINS.

[The correspondence under this head has now reached a point of personality and irrelevance to the subject, beyond which we cannot allow it to go. Our pages are open to any fair discussion, pointedly directed to matters within its scope; but if the disputants are not content with arguing on the subject-matter alone, *we* must content ourselves without their querulous, and too generally aimless, productions. To put an end, then, to this example of the excesses so often indulged in by literary warriors, and at the same time to show that we are entirely uninfluenced on either side, we shall give the pith of Mr. Curr's last letter, headed as above, trusting that the matter may here end.—Ed. P. M. Journal.]

In reference to the first portion of the third paragraph of H. W.'s letter, at page 63 *ante*, he says,—

This denial has reference to the question, whether I constructed a formula to agree with a certain experiment previously made, or whether I applied a formula, previously constructed and published, to an *after* experiment. The experiment was made in May 1848, and the book containing the formula was printed in September 1847, on which authority, I say that he has not only misplaced facts, but committed a dereliction of the propriety due to truth and fair argument.

The book and its date may be seen on application to Mr. Gooch of the Great Western Railway, to whom is was sent by the author on his reading in a newspaper an account of an experiment, by which it seemed as if he were trying to confound together resistances which were subject to distinct laws; and who, after its receipt, at a subsequent meeting of civil engineers, said he intended at a future time to take such resistances *separately*, being the very manner given in the book.

In my first paper, after having applied the formula to a certain experiment, it is said,—"Had the parties present at the trial stated the pressure of the steam on the piston, we should have been in possession of a test or tie-point, which would have proved or disproved the preceding calculations," &c. The reply was, "that it is no easy task to take off indicator diagrams from the cylinder of a locomotive going 43 miles an hour," just as if I had asked for anything so purely ridiculous as an indicator diagram in any such case. Not, however, that the difficulty arises from the cause given by H. W., for whether the engine travels 40 or 4000 miles an hour, the difficulty would be the same; but the absurdity of the attempt would be laughable enough, as the diagram must be begun and completed in the time of a half a revolution of the crank, which is in the sixth or eighth part of one second.

Finding my question was evaded, or shuffled aside, and that a side-wind had been raised to get rid of it, I next asked for the temperature of the steam as an equivalent or substitute for the former question, which H. W. describes as shuffling. I asked for the pressure on the piston, and he thrums on nothing but indicator diagrams. I next ask for the temperature, and he charges me with shuffling.

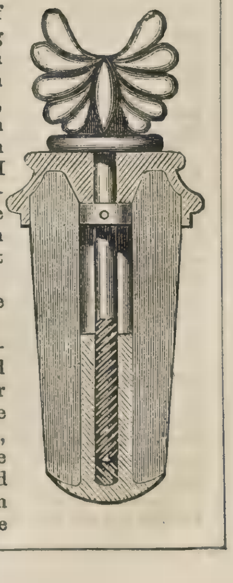
We next come to the narrow question, "whether putting a dynamometer between an engine and train will show how much power is expended by that engine on friction, and by the slipping of the driving wheels?"

What I have said is, that the pressure of the steam on the piston, multiplied by the space it moves in a given time, is the nominal power of the engine, or that of the steam. The beneficial work done is represented by the modulus of resistance to the train, to be ascertained by a dynamometer, multiplied by the space it moves in the time given; and the difference of the two products represents the value of the steam expended in producing motion of the engine, inclusive of the resistance of the air thereto, the friction of the rubbing parts of the engine, inclusive of that on its axles, and likewise the slurring, if such there be, of the driving wheels on the rails.

The resistance of the air may be profitably found by placing the engine, in one experiment, in advance of the train, and in another at its rear; but H. W. has said, more than once, that a dynamometer cannot be placed between the engine and train, which, when he gives a reason, I may believe, but, until then, I esteem the assertion a mistake.

Assuming the problem proposed by Jonathan, and reproposed by H. W. of Paddington, is not to be taken as belonging to the abstract science of nonsense, I answer it emphatically as follows:—The exact number of snow-balls, 3 inches diameter, to boil 2 gallons of water in 1 hour in a tubular boiler, is equal to the number required to boil the same, or any other quantity in 2 hours; the mathematical proof of which I retain till it is demanded, until which period let H. W. wear the crown of absurdity which he has attempted to fix upon me.

MITFORD'S EXPANDING AND CONTRACTING BOTTLE-STOPPER.



Having noticed, in one of your last numbers of the Journal, a patent taken out for a self-acting bottle-stopper, I send you the enclosed sketch from a drawing in my possession, of a stopper which expands and contracts so as to tighten it when in, or loosen it by the contraction in taking out; in fact, it is a combination of cork and corkscrew in one. At the time I first invented this stopper, I took it to Mr. Brockedon, the patentee of the india-rubber cork, who wrote the following on the back:—"This ingenious contrivance was shown to me. I think it is applicable to my patent stopper."

Finding it would be some expense to introduce it, I laid it by, until seeing notice referred to.

Fig. 1 is a section of the cork, showing the internal arrangement. The head and cross-sectioned parts being brass, plated; the body a plain cylinder of india-rubber. The bottom and top caps are made fast to this cylinder; the head, with its pin, being passed through the top, will screw into the nut of the bottom-cap, a small ring being placed underneath the top-cap to prevent the pin from coming out; and it will be seen that, on turning the head to the right or left, the india-rubber body, which forms the cork, will expand or contract at pleasure. For common bottles, the ornamental head may be replaced by a double-milled head.

This was invented in the beginning of 1843. If made with a handsome head, these corks would be very elegant and applicable for decanters.

Bertram Mitford.

Northumberland Lodge, Cheltenham,
June 3, 1849.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF MECHANICAL ENGINEERS.

(Concluded from page 67.)

"On a Patent Solid Wrought-iron Wheel," by Mr. H. Smith of Westbromwich.

This wheel is made entirely under the forge hammer. It is disc-shaped, the disc part being $\frac{5}{8}$ inch thick, and gradually swelling out to the thickness of the nave and tyre. To compare his plan with the ordinary one, the inventor drew a comparison between the most improved wrought-iron wheel of the usual class, and his own. The former is manufactured as follows:—

Pieces of iron, with wedge-shaped ends, are brought together, all converging to a common centre. These are then welded together to form the nave or boss, and the inner ends of the spokes, of the intended wheel. Other T-shaped pieces are then welded to the ends of these spokes, and again to each other, forming the inner tyre of the wheel. This done, a rolled tyre-bar of a suitable length is bended into a circle of a proper diameter to go on the inner tyre, and is welded to form a perfect circular hoop. This hoop is then heated in a furnace and put upon the inner tyre, and then the wheel is immersed in cold water to occasion such an amount of contraction of the tyre as shall firmly fix it upon the wheel. Rivets or bolts are then passed through both to secure them together.

Now, it is submitted that the whole process of thus producing a wheel is open to many well-founded objections, such as the following:—

The possibility of a want of dexterity in the manipulation of the different parts, in the making and bringing them together; the chance of doing so when the iron is not in a proper condition for welding; then, the uncertainty of the hoops or tyres being exactly the same length, or the wheels with the inner tyre of precisely the same diameter; and again, the amount of contraction of the outer tyre depending upon its slow or rapid cooling, will be affected by any variation in the temperature of the wheel itself, and the water in the "bosh" or cooling cistern, and these of course cannot be kept uniform. All these circumstances are opposed to wheels being well made with *loose* tyres, whether with wrought-iron naves and arms, or with cast-iron naves.

In reference to the second head—durability, it is conceived, from the contingencies already alluded to, that it must be obvious, that a wheel made in one piece will be the more lasting; but on this point, the wheel which forms the subject of the present inquiry has other claims to prefer.

In consequence of the iron in the wheel being both granular and laminar, inasmuch as by the mode of manufacture hereafter explained this result is insured, and the grain of the iron being brought to stand at right angles to the direction of the wear, and the body of the iron being of a denser and more compact character than rolled iron, it must doubtless be much stronger and more durable than any rolled tyre-bar of piled iron, which is liable to lamination, and altogether of a softer nature.

Again, the torsive and abrasive effects of the carriage-breaks will not produce the same results on a solid disc wheel, as on one with a loose hoop or tyre of rolled iron.

Then, as regards repairing, when the tyre of the disc wheel is worn down so much as to require a renewal, the wheel can be put in the lathe and turned cylindrical, to receive a tyre in the ordinary way, secured on by bolts screwed into the tyre from the inner side, or by countersunk rivets through the tyre; and it must then be a better wheel than any yet manufactured.

On the subject of cost, it can only be observed at present, that as the first expense does not determine this point, it must be left to be settled by the results of a sufficient experience.

The following is a description of the mode of manufacturing the new solid disc wheels. In the first place, a straight bar of hammered or rolled iron is taken, of 4 or 4½ inches width or more if required, and sufficiently long to form a hoop of such a diameter as is most suitable to make the intended wheel. Other pieces of bar iron are then laid flat and close together, and cut in lengths to the same circle as the hoop, to form the base of a "pile;" the hoop is then placed upon this foundation, and filled with scrap iron. The whole is then put into a reverberatory or heating furnace, and when at the proper heat, is hammered in the tools or dies to form a "mould;" the face of the hammer is recessed in such a shape as to form an approximation to the shape of one side of the intended wheel, but only about two-thirds of the diameter; and the anvil face has a circular recess flat-bottomed, into which the hammer face enters. Two of these "moulds" are then put together, back to back, heated in a similar way, and hammered between the tools or dies; but these tools embrace only a segment of about one-fifth part of the entire wheel. The "mould" is turned round horizontally during this process, being turned a little between each blow of the hammer, and it is thus hammered out to the form and size of the required wheel. The wheel is then put into an annealing furnace, and is planished between tools similar to the last, and the wheel then only requires the tyre and the nave turning in a lathe, and the centre boring out.

By this mode of manufacture, it will be perceived that Low Moor iron, or any other description of iron or steel, can be used if required for the tyre of the wheel, and thus in all cases insure a clean wearing surface, and a compound character of fibrous and granulated iron, which it is believed no other system of making wheels affords. The centres for large spoke wheels are also manufactured in one solid piece in a similar manner by tools or dies. The top and bottom tools are both alike, and are recessed in the form of the nave of the intended wheel with a short portion of each of the spokes radiating from the nave. The centre of the wheel is thus stamped out by the hammer with a portion of each of the spokes about a foot long, ready for welding on to the T pieces, to form the inner tyre and the remaining portion of the spokes. A thin web or fin is left in the centre between the spokes, which is afterwards cut out by the smith. The object of this construction is to surpass in certainty of soundness the precarious method of making them at present in use. It is unnecessary to urge the importance of obviating, as far as possible, the occurrence of such accidents as have too frequently happened in consequence of defects of railway wheels; but a few of these cases may be alluded to here, in illustration of the subject.

The accident on the Edinburgh and Northern Railway in October last, when the tyre of the leading wheel of the engine broke, and threw the train off the line: that on the East Lancashire Railway in November last, where the tyre broke off one of the carriage wheels: that upon the Brighton Railway in September last, when the tyre of one of the engine wheels broke, throwing the train off the line: and that upon the Great Western Railway, about two years ago, where the tyre of a carriage wheel broke, and a portion of it broke through a carriage, causing a fatal accident.

With the view of obtaining some practical information upon the comparative resistance of the air to the revolution of the disc wheels and of the ordinary spoke wheels, some experiments have been tried at the Vulcan Iron Works, Westbromwich, by Mr. Henry Smith, with the assistance of Mr. Marshall, the Secretary of the Institution; and the results of these experiments are appended in the following Table.

EXPERIMENTS ON THE RESISTANCE OF THE AIR TO THE SPOKES OF WHEELS.

Vulcan Iron Works, April 17, 1849.

No. of Experiment.	Description of Wheel.	Weight of Wheel.	Weight suspended on rope.	Distance fallen by Weight.	Total Time of Revolution of Wheel.	Total number of Revolutions of Wheel.	Average Speed per hour of Wheel.	Length of Rope.	Time before Rope was detached.	Revolutions before Rope was detached.	Weight of the Tail Rope.	
No.	Wheel.	lbs.	lbs.	Feet	Secs.	No.	Mls	Feet	Secs	No.	lbs.	REMARKS.
1	Losh	451	56	270	55	148	17	270	15	38	0	No tail rope; the rope was detached before weight touched the ground.
2	Disc	414	56	270	62	161	17	270	15	38	0	
3	Losh	451	56	279	60	166	18	355	17	50	7	With tail rope.
4	Haddan	423	56	279	60½	176	19	355	17	50	7	Ditto.
5	Disc	414	56	279	68	220	21	355	17	50	7	Ditto.
6	Disc	414	56	279	66	222	22	355	17	50	7	Ditto.
7	Disc	414	71½	279	75	257	22	355	12	50	7	Ditto, and stone fixed on iron weight.

These experiments were performed at an old mine shaft 279 feet deep. The axle was placed across the top of the shaft, and carried by two bearings with brass steps; the wheel under experiment was fixed on one end of the axle outside the bearing, and the counter connected to the other end of the axle. The counter was so graduated and arranged that the most correct observation could be taken of the number of revolutions completed in each case.

A drum 2 feet 3½ inches diameter was fixed on the centre of the axle, and a rope $\frac{3}{8}$ inch diameter was coiled on the drum, with the moving weight attached to the end of it, hanging over the centre of the shaft; the other end was not attached to the drum, but held only by the grip of the second turn of the rope, so that when the rope was run off the drum by the weight falling to the bottom of the shaft, the end of the rope detached itself from the drum without any check. As there was no means of descending the shaft to bring up the rope and weight, a tail rope of the same length and size as the main rope was attached to the weight at one end, and the other end made fast at the top of the shaft, the rope hanging double halfway down the shaft; this served to bring up the weight and main rope after they had fallen to the bottom of the shaft in each experiment. These two ropes weighed 7 lbs. each, and the weight of the main rope caused a gradual acceleration in the moving weight, varying from nothing at the beginning of the descent to 7 lbs. at the end; whilst the tail rope, acting at first with half its weight, caused an increase varying from 3½ lbs. to nothing at the end. The result was, therefore, a total increase of the moving power, varying from 3½ lbs. at the beginning of the fall, to 7 lbs. at the end; and as this was the same in each case, and the moving weight was also the same (56 lbs.), its effect may be neglected in ascertaining the comparative results for the present purpose.

The wheels tried in the experiments were one of the solid wrought-iron disc wheels, a wrought-iron flat-spoked wheel of Losh's pattern, with spokes 3$\frac{1}{16}$ inches broad, and a wrought-iron flat-spoked wheel of Haddan's pattern, with spokes 3$\frac{1}{16}$

inches broad. These wheels were selected as near the same weight as was practicable, Losh's wheel being one-eleventh heavier than the disc wheel, and Haddan's wheel one-forty-sixth heavier than the disc wheel; all the wheels were 3 feet diameter.

In the four experiments, Nos. 3, 4, 5, and 6 (see the preceding Table), the time in which the rope was run off the drum was the same in each case—17 seconds; and as the number of revolutions in that time was also the same in each case (50), in consequence of the same rope being used, it follows that the velocity of the wheel at the moment of the power being detached was the same in each case, and consequently the comparative resistance in each case is indicated by the comparative length of time that the wheels continued in motion after the power was detached. In the experiments, Nos. 1 and 2, the weight and rope were dropped down the shaft without the addition of a tail rope to pull them up again, and the rope was shortened to 9 feet less than the depth of the shaft, so as to ascertain the exact moment of the power being detached from the drum. The time was the same in both cases, 15 seconds from starting to the power being detached, and the number of revolutions also the same, 38: this gives an average velocity of the circumference of the wheel from starting equal to 16 miles an hour, or a final velocity of about 32 miles an hour, at the moment of the power being detached.

In No. 1 experiment with Losh's wheel, the total time of the wheel revolving was 55 seconds, and in No. 2 experiment with the disc wheel it was 62 seconds; then deducting in each case the 15 seconds during which the power was in action, the results are 40 and 47 seconds respectively for the time of motion after the power was detached; which are in the proportion of 100 to 118, showing *that* 18 *per cent. more resistance* was experienced by the spoke wheel than by the disc wheel. In the four experiments, Nos. 3, 4, 5, and 6, the time was 17 seconds from starting to the moment of the rope being detached, and as the rope was in these cases longer than the depth of the shaft, so that the weight stopped at the bottom before the rope was detached from the drum, 14 seconds may be taken as the time during which the power was acting; in Nos. 1 and 2 experiments, where the weight of the tail rope was not acting, this time was ascertained to be 15 seconds.

In No. 3 experiment with Losh's wheel, the total time of the wheel revolving was 60 seconds; in No. 4 with Haddan's wheel, it was 60½ seconds; in No. 5 with the disc wheel, the total time was 68 seconds; and in No. 6 with the same wheel, 66 seconds—the mean time of the disc wheel being 67 seconds.

Then deducting in each case the 14 seconds during which the power was in action, the results are 46 seconds with Losh's wheel, and 53 seconds with the disc wheel, for the time of motion after the power was detached; which are in the proportion of 100 to 115, showing that 15 *per cent. more resistance* was experienced by the spoke wheel than by the disc wheel.

The average result from both sets of experiments is 16½ *per cent.* difference of resistance in favour of the disc wheel, and this is attributable to the additional resistance of the air caused by the flat spokes of the spoke wheel, as the friction of the axle caused the same resistance in each case; the weight being nearly the same of each wheel, and to prevent any change in the friction of the axle, the wheels were changed without taking the axle out of its bearings during the experiments. The axle journals were 2¼ inches diameter, and 2½ inches length; and the friction of the journals was overcome by a weight of 15½ lbs. acting on the drum, when the wheel was upon the axle, and by a weight of 5¾ lbs. when the wheel was taken off.

As these experiments were made with wheels revolving on a stationary axle, it is requisite to consider what would be the comparative effect, if the wheels were rolling on their circumference whilst revolving at the same rate on their axle, as in the practical case of the wheels of railway carriages running on a railway. In the former case, the motion of the spokes is at a uniform velocity, and always at right angles to the direction of the spokes; but in the latter case of a rolling wheel, the motion of the spokes is at a varying velocity, and always inclined obliquely to the direction of the spokes, except at the moment of each spoke being in the vertical position. The outer ends of the spokes move in a cycloidal curve, having double the velocity of the revolution of the wheel when they arrive at the top of the wheel, but becoming stationary at the moment of touching the rail at the bottom of the wheel; the average velocity of the outer ends of the spokes is about 1¼ times greater than when the wheel revolves on a stationary axle at the same rate of revolution. The average velocity of the inner ends of the spokes is about 3 times greater when rolling than when revolving on a stationary axle. As the resistance of the air increases in proportion to the square of the velocity, the average resistance to the outer and inner ends of the spokes will be about 1½ and 9 times respectively greater in the former than in the latter case. But this is reduced by the oblique position of the spokes as regards the direction of their motion in the rolling wheel; the motion of the spokes being twice during each revolution in the direction of the spokes, and, consequently, the resistance of the air reduced to nothing at those points. By measuring upon the diagram the comparative velocity of several points in a spoke in various positions during a complete revolution of the wheel, and the inclination of the spoke to the direction in each of these positions, the following approximate result has been obtained:—that the total resistance of the air to the spokes when the wheel is rolling, is 3 times the total resistance to the same spokes when the wheel is revolving at the same rate of revolution on a stationary axle.

It follows, that the result of the foregoing experiments has to be multiplied by 3, and, consequently, the excess of the resistance of the air to the spoke wheel over the disc wheel would have been 3 times 16½, or 49½ per cent., if the wheels had been rolling, in this case, instead of revolving on a stationary axle. This excess of resistance of the spoke wheel would not be so great in the practical case of the wheels of a railway carriage running on a railway, as the friction of the axle journals is greater in that case than in the experiments, from the weight pressing upon them being greater; and, consequently, the resistance of the air to the spokes of the wheel would then bear a less proportion to the friction of the axle journals.

Mr. Smith exhibited a finished specimen of his wheel, and one of the moulds in the first stage of manufacture; also a centre for a wrought-iron spoke wheel, which he had manufactured that day: it rang as clear as a bell when struck by a hammer.

Mr. M'Connell said, he had tried two pairs of these wheel centres at Wolverton, and had found them perfectly solid, and they were an excellent job; they were for the leading and trailing wheels of an engine 3 feet 9 inches diameter.

Mr. Smith said, in answer to questions, that his hammer with which the wheels were forged was rather more than 9 tons weight; it was a helve taking up under the belly, and was driven by bands. The weight of the finished disc wheel was about 4¾ cwt.; it was made with the first tools that he had started with, and he had adhered at present to his original section of wheel, but he did not profess it to be the best form of section that might be adopted. He had made about 200 of these wheels; there were some now at work on the Birmingham and Gloucester line, and he had an order to prepare some for the travelling post-office, to register the number of miles run by them. As to the cost of these wheels, he was ready to put himself in competition with other parties.

The Chairman remarked, that the durability or life of the body of the wheel was so very much greater than that of the tyre of the wheel, which must be renewed when only about a tenth of the life of the wheel was gone, and would then require a secondary process to put on the new tyre; and, consequently, it appeared to him preferable not to incur any additional expense and trouble by forging the tyre on to the wheel, but to manufacture the disc alone, and put on a separate tyre in the first instance.

Mr. Smith replied, that it was not any more trouble to forge the wheel with the tyre than without it; it was easily done, and the cost of manufacturing the wheel would be less than putting on a separate tyre. There would be a little more trouble and expense in retyring the wheel for the first time, but he thought that the iron of the tyre would be much more durable than any rolled tyre could be, on account of the process of manufacture.

Mr. Woodhouse asked what advantage the wheel would possess over a cast-iron wheel if it were forged without the tyre; but he thought there was certainly danger of fracture from expansion in a cast-iron disc wheel.

Mr. Beyer remarked, that he had seen some cast-iron wheels that he thought would last as long as wrought-iron ones, and he never could understand why they were not more used; there were many wheels of cast-iron, even large driving wheels of 6 feet diameter, that had been running many years, and he thought it was an important question of economy in railways.

The Chairman observed, that when locomotive engines were begun, some 25 years ago, they were driven to wrought-iron wheels, and thought it a great advantage; and he thought that for rapid railway travelling, they must admit, as a body of engineers, that wrought-iron was better than cast-iron for such purposes. The present facilities for the manufacture of wrought-iron had been so strikingly shown to them on the present occasion, that he thought it was hardly possible to save anything worth mentioning by the adoption of cast-iron, particularly in the expense of a pair of large driving wheels.

The meeting concluded with the reading of a paper by Mr. Hoby of Brighton, "On the Construction of Permanent Way," which will be given next month.

INSTITUTION OF CIVIL ENGINEERS.

President's Converzatione.

May 22, 1849.

Mr. Field, the President of the Institution, held his Annual Converzatione at the house of the Institution, on Tuesday, the 22d of May. This is the second time these meetings have been held at the house of the Institution; and the general arrangements gave even more satisfaction than those of last year. The visitors were most numerous, and much attention was bestowed upon the extensive collection of works of art and models.

In so large an assemblage of interesting productions, we can only here notice a few, and we must give the place of honour to the works of art. On the walls were the portraits of the celebrated engineers, Locke, Brunel, Fairbairn, and Mr. Isambaud Brunel, by Grant, Hornby, and Patten. Around the walls, and on the tables, were beautiful specimens of the pencils of Etty, Haghe, Lee, Fahey, Scanlan, Pitt, Wood, Boxall, Richmond, Jutsum, Forrester, and many others.

Mr. Thomas contributed a beautiful marble chimney-piece, intended for Mr. Peto, and a statuette of Ariel commanding the Storm. Mr. Behnes also sent an excellent bust of Mr. C. Barry. Mr. Deighton's model of the Kneller Hall Training School was an excellent specimen of Mr. Mair's architectural skill and taste. Among the principal of Salter's models, were Mr. Fowler's New Holland Pier, and his Girder Bridge over the Trent; Mr. Jee's Dinting Vale Viaduct; Captain Moorsom's Viaduct on the Waterford Railway; Mr. G. Edwards' Bridge over the Waveney; Mr. Grainger's Bridge over the Calder; Mr. Stephenson's Tubular Bridge over the Menai Straits; and of the Bishop's Rock Pile Light-House, erecting in a most perilous position, by Messrs. Walten and Burges. Cochrane's Sawing Machine excited great attention; as did Gordon's Cata-Dioptric arrangement, and Wilkins' Fourth Order Dioptric Light Apparatus.

The Earl of Rosse contributed the model of his beautiful telescope, as did Mr. Cowper those of his own, Mr. Lassels', and Mr. Nasmyth's methods of mounting equatorial instruments.

The Electric Telegraph Company had a fine collection of working instruments, and Messrs. Brett and Little contributed a series of theirs.

Mr. Strode's self-igniting gas-burner, and Mr. Biddle's self-regulating gas-burner, were both much admired.

Messrs. Adams exhibited a complete series of improvements in railway carriages, permanent way, &c.; and Messrs. Johnson and Cammell an equally complete assortment of steel springs, files, &c.

Mr. Roberts had a beautiful collection of models and working instruments, exhibiting his usual talent of invention and beauty of execution.

Messrs. Mitchell had a series of models of the various applications and mode of using the screw-pile and mooring. Very complete models were also shown, by Mr. Woods, of Clement's sugar-refinery, and of a rotative dynamometer.

Messrs. James Wall and Co. sent two curious models of an engine with an oscillating cylinder, made by Murdock in 1785, and of a locomotive engine by the same ingenious man prior to 1784.

Messrs. Ransome and May exhibited some shavings of cast-iron, cut by tools of immense power, from railway wheels.

Messrs. Maudslay sent a model of a large gun, intended to be loaded and sponged by the breach; and a method of feathering paddles.

Messrs. Seaward and Co. contributed a series of models of plans for raising stern-propellers; and Messrs. Chubb also sent a beautiful specimen of an iron chest, very superior in workmanship and design.

Tuesday, June 5, 1849.

Joshua Field, Esq., President, in the Chair.

Description of a Method of Rolling Bars for Suspension Bridges, and other like Purposes, by Mr. Thomas Howard, Assoc. Inst. C.E. It was described that by the ordinary process of manufacture, the head, or end of the link, out of which the eye, or hole for the connecting pin was bored, had been sometimes welded on to a parallel-rolled bar, or, at other times, been hammered to the required form; both these methods were, however, objectionable, owing, in the former case, to the insecurity, and in the latter to the tediousness and expense. By the method introduced by Mr. Howard, the bars were rolled at once into the requisite form; the shingle, or faggot, was first passed longitudinally, at a welding heat, through grooved rollers, in the ordinary manner, and then, before being drawn down to the intended thickness, was carried to rollers having bosses, or increased diameters, at the places corresponding to the heads to be produced, and there passed to and fro between the rollers transversely, or across the breadth of the bar, thus receiving a pressure only at the enlarged parts of the rollers, which gave the necessary increase of breadth at the heads; it was then taken to plain finishing rollers, and drawn out longitudinally in the usual manner, until it attained the required length and thickness; the heads being afterwards trimmed by machinery to the exact dimensions, and the holes drilled for the pins.

It was stated that the chains of the large suspension bridge, erected by Mr. W. Tierney Clarke over the Danube, at Pesth, which lately so satisfactorily withstood the heavy strain brought upon it by a retreating army, were constructed on this system at the King and Queen Iron Works at Rotherhithe; as were those for lifting the tubular bridge at Conway, and over the Menai Straits; and also that the links for a bridge now erecting by Mr. Vignoles, at Kieff, in Russia, were manufactured by another firm, under license to use Mr. Howard's system.

Some interesting observations were recorded of the results of the experiments for determining the strength of these bars, showing them to possess great elasticity and freedom from permanent set.

The discussion elicited some useful remarks as to proportions of the area of the body and of the head, and of the diameter of the pin, which, it was shown, had much influence on the resisting power of the heads—the larger the pin, the less being the tendency to rupture the eye.

The process appeared to be admitted as a great improvement on the ordinary mode of manufacture, and tending to give confidence to the Engineer, that his designs could be executed in metal, uninjured by manipulation.

INSTITUTE OF BRITISH ARCHITECTS.—ORDINARY GENERAL MEETING.—June 4.

T. Bellamy, Vice-President, in the Chair.

T. R. Macquoid was elected an Associate.

A paper was read by G. Burnell, Esq., Jun., "On the Building Materials employed at Paris, and in the valley of the Lower Seine." The author gave a detailed account of the qualities of the principal building materials used by the architects and engineers of Paris and the valley of the Lower Seine, accompanied by some statistical statements of the quantities used in those localities. In comparing these with the quantities employed in England, the most remarkable difference appeared to exist in the greater use in this country of iron, especially *cast* iron, which may be accounted for by that material being much dearer in France. The use of gypsum in France, which we call Plaster of Paris, instead of mortar made wholly from lime, for filling in the internal partitions and for forming the floors and ceilings of the rooms, was alluded to as rendering the buildings less combustible than in England. Mr. Burnell commented on the bad system adopted in building some of the modern houses in Paris, where, by using squared stones for the fronts next the streets, rubble stone for the party walls, and timber framing filled in with plaster for the back walls,—fissures and cracks are produced in consequence of the unequal combination and the different expansive power of the materials thus applied. For the covering of the roofs, slates and tiles are used in France, but zinc is more generally applied in that country than in England—the dryness of the climate rendering it less liable to corrode than with us; being much cheaper than either copper or lead, it is frequently employed where those metals would be applied in England. Mr. Burnell urged the necessity of more accurate and detailed investigations of the chemical properties of building materials than have hitherto been considered necessary,—he observed that "little is here known, comparatively speaking, of the chemistry of the art of building, that little having principally been gleaned from the scientific researches of the French authors."

SOCIETY OF ARTS.

May 9, 1849.

Mr. Digby Wyatt, architect, read a paper on Metal-work, and its artistic design. The paper commenced with some remarks on the absolute necessity of the study of *specific design*, in order to confine the errant imaginations of artists within reasonable bounds, and in order fully to take advantage of all the natural properties, mechanical capabilities, and recorded experiences, peculiarly belonging to all materials, in the elaboration of which it is requisite that an alliance between use and beauty should be effected. Mr. Wyatt maintained that all propriety and perfection in manufacturing design was derivable from the result of such studies, and that the more clearly the objective individuality of every ingredient was preserved and enunciated in the finished article, the more satisfactory, to both eye and mind, would the character of its ornamentation appear.

The *specific design* of metal-work was described as based on three great studies, a thorough knowledge of the general conditions of which was requisite to all who would either manufacture, compose, or criticise, in any one of its numerous ramifications. The first of these was, that of the distinctive characteristics and appliances of each metal; the second, its form as modified by all the mechanical processes of manufacture; and the third, a thorough analytical and critical acquaintance with all the best models in which reasonable and good principles of art can be traced, and through modifications of which pleasing associations of idea may be commanded at the will of the designer. In accordance with his scheme, thus laid down, Mr. Wyatt proceeded to deduce the correct theory of the manufacture of each metal from the properties with which it had been endowed by nature. He then described, at considerable length, the processes by which almost all objects in metal must be produced, dwelling especially on those best harmonising with the character of each substance, and the accredited conventionalities of its use. Thus he emphaticised the refining, beating into thin sheets, wire-drawing, stamping, and torsion of gold; the beating-in plate, gilding, dead-silvering, parcel-gilding, soldering, &c. of silver; the hollow casting of bronze, by means of wax, and of moulds *a bon creux;* and the solid founding of iron in complex forms. Having disposed of the *structural* processes, Mr. Wyatt rapidly analysed the *decorative*, or superficial, enumerating and sketching out the leading peculiarities of engraving, matting, niello, cooking, burnishing, the six chief divisions of enamel, and three or four varieties of damascening (*tauscia, lavoro all'agemina*). The mechanical limits of the art being thus pointed out, the impressions suggested by the history of past *chef-d'œuvres* were then cursorily examined. The extreme antiquity of metal-work, and its details among the Jews, Egyptians, Assyrians, Persians, Greeks, Etrurians, and Romans, was demonstrated from descriptions furnished by various authors, and by monuments of wonderful merit still existing. The speaker then glanced at the mediæval portion of his subject, and concluded by calling attention to the beautiful examples of metal-work, ancient and modern, by which he was surrounded, and urging the necessity of a systematic recognition of first principles and practical details, to be superadded to the study of beauty and fine art in the abstract.

In addition to the articles of gold and silver-plate, the bronzes, and fine iron-castings which had been contributed to the exposition of the Society, the paper was illustrated by a quantity of beautiful specimens of ancient metal-work, most kindly lent for the occasion by Mr. Pratt, Mr. Webb, Mr. Hawkins, Mr. Hardwick, and several other gentlemen. The room was hung round with a series of drawings of the highest interest, a portion of the stores accumulated by Mr. Wyatt for his forthcoming work upon the subject.

MONTHLY NOTES.

Preston Institution Bazaar Gazette.—We have had for some time laying before us, No. 4 of a small sheet of 8 pages, bearing the title we have given above. As its name implies, it gives an account of the doings at Preston, on the occasion of holding a bazaar for the benefit of the Preston Institution for the Diffusion of Knowledge. As mentioned in our notice of the Report of this Institution for 1848,* the works on the new and handsome building, erecting near the well-known promenade of Avenham Walks, having been stopped for a long period for want of funds, the friends of the Institution determined to try the experiment of a bazaar to supply the deficiency. As we gather from the "Gazette," the proposal was first made in 1845; but, from various causes, its prosecution has been delayed from time to time, until about a year ago, when a resolution was passed that it should be carried into effect, and accordingly, in April last, the affair came off. The Exchange Rooms were set aside for the purpose—the waggons discharged their voluminous cargoes—the packages were opened—and the bazaar commenced. Multifarious were the contents of the rooms, and well they appear to have answered their purpose; for the receipts of the first day's sales and tickets amounted to the handsome sum of £429, and, including certain sums paid in as subscriptions to incomplete raffles, £630 was netted. The faculty of spending on the part of the public, and of receiving on that of the fair dealers, appears to have continued throughout the week with little abatement; for the close of the accounts showed a total receipt—including, however, some munificent donations—of £1,739. With such a magnificent sum in hand, we may now reasonably hope soon to find Preston in possession of a building suited for the purposes of its most useful institution.

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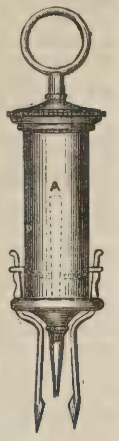
* Page 233, vol. i.

Baldwin's Process for Splitting Paper.—Since we wrote the remarks on this process, which appeared in our last number, Mr. Baldwin has favoured us with several specimens of his ingenious art, consisting of a series of wood engravings, of various sizes, which have had letterpress split from their back, being afterwards mounted on India paper to represent "proofs." One of the subjects is an engraving from Gainsborough's celebrated picture, "Repose," from the *Illustrated London News.* The size of this, nine inches by seven, constitutes it a tolerable good example of the accuracy of the split; and when it is remembered that the paper is nothing more than the ordinary printing kind, the performance certainly appears astonishing. Another of a rather smaller size, "Andrea del Sarto painting the Fresco of the Madonna del Sacco," painted by Baron, from the *Pictorial Times*, exhibits the fine effect which may be thus given to ordinary newspaper engravings. The extreme thinness of the paper gives it the appearance, when mounted upon India paper, of a fine proof. Some of the specimens are split only half through, showing one portion in its original unsplit state. Amongst these, we have a sheet from Lavater, having a fine engraving on each side. If mounted in the ordinary way, of course one picture must be sacrificed; but, by splitting the sheet, we obtain both in good preservation. One or two examples are on very thin paper, with letterpress behind. Yet even in the case of the thinnest, the inventor appears to meet with no difficulty in obtaining two perfect sheets.

Hutchinson's Ear-Syringe.—The ordinary syringe, as employed for ear injections, is a most inconvenient instrument. For want of some mechanical contrivance to hold the ear open, so as to receive the discharge fairly, failures frequently occur, and a needless repetition of operations is involved. Our sketch exhibits a half-size view of a complete syringe, fitted with a simple arrangement for expanding the ear during injection, and thus obviating the difficulty in question. It is the invention of Messrs. Hutchinson of Norfolk Street, Sheffield, and consists merely of a dilator, which, when the mouth-piece of the syringe is inserted, expands the part surrounding it, and provides a free passage for the fluid. This is done by pressing down the dotted lever, A, which acts upon the two bent levers projecting beyond the mouth-piece, causing them to open and hold back the parts.



Waymouth's Improved Globe.—The terrestrial globe with an embossed surface to represent the outline of the earth, invented by Mr. Waymouth of Nailsea, and noticed by us last month, is now moulded in gutta percha by the London Company. It is nine inches in diameter, and fitted up on a circular mahogany pedestal, is supplied for 25s. This is one of the many valuable uses to which the new gum is being daily applied.

Roberts' Improvements in Horticultural Apparatus.—The divided strawberry tile of Mr. Roberts, 24 Eastcheap, London, was figured and described by us in vol. i. page 247, as a valuable addition to the gardener's utensils. We have now to notice some additional productions of a similar class, by the same hand. The first of these is a modification of the strawberry tile in question, which is rectangular, and, in place of having feet on its lower side, is fitted on its two halves with two parallel ledges or ribs, answering as supports, upon which it stands. These tiles are easily placed round the plants; they shade the surrounding earth, and the heat absorbed by them by day nourishes the plant at night. The same principle is also carried out in tiles for melons, sea-kale, celery, and grapes. In giving his directions for making a melon bed for the tiles, the inventor states that it should face the south; the north end to be 3 feet 6 inches high; the sides 20 feet long; width, 6 feet, sloping down to 4 inches in height, and built either of bricks or timber, but bricks are preferable. When the excavation for the bed is made, the bottom is filled in with brushwood, flower-stalks, or old litter, to within 12 inches of the top, and trodden firmly down, covering it over with good earth. Then, two flour barrels, with their ends knocked out, are to be sawn through the middle, and set overhead in the earth, at equal distances asunder, down the centre. These are filled with rotten manure, one-half from the stable, the other from the piggery, mixed, and covered with about 4 inches of maiden earth from an old pasture. Three or four seeds of melon or cucumber are to be planted in each of these, covering them over with a hand-glass, and watering occasionally until the plants are established. When the time for removal is fixed, the whole bed is covered with the tiles, pegging the plants, as they require it, to their surface. Another branch of improvement refers to a method of maturing the early ripening of grapes, figs, and similar fruits, by means of flat rectangular tiles, punctured with small holes, and having a ledge formed on one side. Mr. Roberts' sketch represents this curious substitute for walls and fences in fruit-growing, his plan being to erect a frame 12 feet long, and 5 feet high at the back, sloping down to 2 feet at the front. Across this, laths are laid about 14 inches apart, and upon these the tiles are placed, being attached by copper wires passed through their small holes. The vine, or other tree, is planted close to the lower edge of this frame, and the branches are carried up and spread over the tiles, to which they are fastened by wire. It is stated that the heat absorbed by the tiles in the day, is given off to the plants at night with great effect, in rapidly nourishing and ripening the fruit.

Bishop's Metallic Box End Protector.—A design, bearing this title, has recently been registered by Mr. W. Bishop of Boston, Lincolnshire. The improvement is applicable to all small boxes of card-board or other material, and consists simply in the application of two slightly-grooved metallic rings, one on each end of the box, embracing the angular circumferential edges formed by the junction of the side with the ends. The plan will undoubtedly strengthen considerably boxes of this construction, and, in addition, it adds strength to the article.

Holder for Whips.—Messrs. W. and G. Ashford, of Birmingham, whip-makers, have registered a clever design for a holder for whips or sticks, of which our two accompanying sketches will afford an explanation. Fig. 1 is a vertical section of the holder, and fig. 2 is an end view. A, Is the body of the holder, made hollow, and closed at the bottom, but left open at the top, where it terminates in a ring, B, of ivory or metal. C, Is a disc of vulcanized india-rubber, or other elastic substance, which is stretched across the opening in the top of the holder, and has an orifice, D, cut in its centre, to allow of the whip or stick being passed through and into the body of the holder when required. A few radial cuts or slits are also made in this disc, to facilitate the entrance and withdrawal of the whip, and also to allow of its adapting itself more fully and securely to the form of the article to be held. The orifice, D, is made of much smaller diameter than the whip, in order that it may exert an elastic springy action, and hold it firm.

Fig. 1.

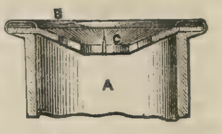
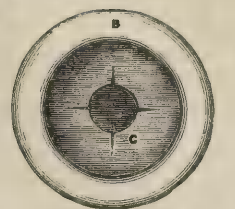


Fig. 2.



Preparation of Charcoal by Highly-heated Steam.—M. Violette, whose valuable experiments on the steam preparation of wood were noticed by us at page 106, vol. i., has succeeded in applying his plan to the manufacture of charcoal; and the results of his trials show, not only an increase in the strength of the gunpowder made from the charcoal, but also some increase in the yield of the substance. He has ascertained, that at 392° Fahr., wood is not charred; that at 482°, an imperfect kind of charcoal, termed *brulots*, is obtained; and that at 572°, the brown charcoal is formed; whilst a heat of 662° gives the black charcoal. Two other French engineers, Messrs. Thomas and Laurent, having hit upon the plan of reviving animal black by means of surcharged steam, M. Violette was induced to attempt its use in carbonization; and, after the primary trials, which gave promise of value, the Minister of War advanced 5,000 francs for the carrying out of the invention. In the apparatus employed, the steam was supplied by an ordinary boiler, and is passed off through a helical worm, 8 inches in diameter, and 66 feet long, set in a furnace, which thus raises the steam temperature to 572° Fahr. for brown charcoal. It surrounds and penetrates into a cylinder containing the wood, which it chars, leaving the receiver charged with the products of distillation. This arrangement has been in active operation at the gunpowder mills of Esquerdes for a year back, supplying all the charcoal required there. The yield of brown charcoal is found to be from 33 to 37 per cent. of the wood, against 18 per cent. of brown, or 14 per cent. of black charcoal, by the old process. M. Violette states, that bread-baking may be most successfully accomplished by using steam at 392°, as well as the cooking of meat, the extraction of pyroligneous acid, and pyroxylic spirit.

Finlay's Vacuum Gas Lamp Suspender.—We have before us one of the tubes and pistons employed by Mr. Finlay, of Buchanan Street, for supporting his gasaliers, under the patent obtained by him in 1845, illustrating the remarkable efficiency of this method of atmospheric suspension. The diameter of the piston is about 1¼ inches, and the atmospheric pressure upon it, when in action, is equal to about 12 lbs. The suspending piston is attached to the lower extremity of a tubular rod, attached to and pendant from the ceiling, and over this the barrel carrying the lustres slides. At the point of junction of the barrel with the lustres, the gas tube for conveying the gas to the burners is attached, passing air-tight through the centre of the piston. When the lamp is put in action, the barrel is raised until the piston touches its bottom, and a quantity of oil is then poured upon the piston to keep it tight. In raising the barrel, any air which may have collected beneath the piston is forced out through a small leather valve opening upwards, and by this simple means any casual leakage may be obviated by merely pushing up the lamp to the top of its travel. The piston is formed of brass, with a small cup leather, and works so accurately, that, in a well-made lamp, after several days' suspension, no appreciable leakage to the interior of the barrel takes place. The plan has also the advantage that the lamp may be turned round with ease as required, as there are no weights or chains to interfere with its movements.

ENGLISH PATENTS.

Sealed from 22d May, 1849, *to 14th June*, 1849.

Pierre Armand Lecomte de Fontainemoreau, South-street, Finsbury,—"Certain improvements in weaving."—(Being a communication.)—May 22d.

Francis Edward Colegrave, Brighton, gentleman,—"Improvements in the means of communicating between the passengers and guard of a railway train, or between the guard and engine-driver; parts of which improvements are also applicable to working signals on railways."—22d.

Solomon Israel Da Costa, St. Helen's, London, civil engineer,—"Improvements in vessels for holding solids or fluids, and in machinery for manufacturing such vessels."—22d.

Rees Reece, St. John-street, Smithfield, and Astley Paston Price, Margate, Kent, chemist,—"Improvements in the manufacture and refining of sugar or saccharine matters."—24th.

Andrew Crosse, Gloucester-place, New-road, Middlesex, Esq.—"Improvements in tanning hides and skins, and also in dyeing fabrics and substances."—24th.

Thomas Goodfellow, Tunstall, Stafford, earthenware manufacturer, and George Goodfellow, Shelton, in the same county, potter,—"Improvements in the method or methods of preparing plastic materials for manufacturing purposes."—24th.

Andrew Smith, St. James's, Westminster, engineer,—"Improvements in machinery for, or methods of, manufacturing rope or cordage, and improved modes of fitting and using the same."—24th.

Frederick Steiner, Hyndburn, near Accrington, Lancaster, turkey-red dyer,—"Improved processes and apparatus to be used in the Turkey-red dye on cotton and its fabrics."—24th.

Edmund Grundy, Bury, Lancashire, woollen manufacturer, and Jacob Farrow, of the same place, manager,—"Certain improvements in machinery or apparatus for preparing wool for spinning, and also improvements in machinery or apparatus for spinning wool, and other fibrous substances."—29th.

David Smith, New York, America, lead manufacturer,—"Certain new and useful improvements in the means of manufacturing certain articles in lead."—29th.

Richard Edward Hodges, Bycroft, Hereford, gent.,—"Improvements in mechanical purchases, which are also applicable in whole, or in part, to projectiles."—29th.

John Dingdale, and Edward Birch, both of Manchester, tool and machine makers,—"Certain improvements in constructing and propelling ships, or other vessels."—31st.

William Goose, Birmingham, manufacturer,—"Certain improved machinery for manufacturing mills."—(Being a communication.)—June 5.

William Henry Smith, Fitzroy-square, civil engineer,—"Certain improvements in breakwaters, beacons, and moorings, parts of which are applicable to other purposes."—5th.

George Simpson, Buchanan-street, Glasgow, civil and mining engineer,—"A certain improvement or improvements in the machinery, apparatus, or means of raising, lowering, supporting, moving, or transporting heavy bodies."—5th.

Samuel Dunn, Doncaster, gent.,—"Improvements in constructing tunnels, and in apparatus to be used for such or similar purposes."—5th.

Thomas Lawes, City-road, gent.,—"Improvements in generating steam, and in the means of obtaining and applying motive power."—5th.

William Edward Newton, Chancery-lane, civil engineer,—"Improvements in stoves, grates, or fire-places, and in warming or heating buildings.—(Being a communication.)—5th.

Thomas Jowett, Burrage House, Bingley, York, stuff manufacturer,—"Certain improvements in the method of stopping power looms, and preventing injury to the cloth, or fabric, in the course of being woven."—5th.

George Hinton Bovill, Abchurch-lane, London, engineer,—"Improvements in manufacturing wheat and other grain into meal and flour."—5th.

Jaques Hulot, Rue St. Joseph, Paris, manufacturer of fabrics,—"Improvements in the manufacture of the fronts of shirts."—5th.

Daniel Miller, civil engineer, Glasgow,—"Certain improvements in the mode of drawing ships up an inclined plane out of water."—5th.

Victor Hippolyte Laurent, France, engineer,—"Improvements in looms for weaving."—5th.

Osgood Field, London, merchant,—"Improvements in anchors."—(Being a communication.)—5th.

A grant of an extension of her Majesty's letters patent for the term of five years from the 27th of May, 1849, to Thomas Hornby Birley, assignee of George Bodmer, the original inventor of an invention for "certain improvements in machinery for preparing, roving, and spinning cotton and wool."—5th.

Thomas Masters, Regent-street, gent..—"Certain improvements in the construction and arrangement of apparatus for cooking, heating, and evaporating fluids, and obtaining decoctions and infusions from certain vegetable and animal matters, parts of which improvements are applicable to certain chemical processes."—7th.

Edward John Payne, Chancery-lane, London,—"Improvements in marine vessels, in apparatus for the preservation of human life, and in moulding, joining, and finishing hollow and solid figures, composed wholly or in part of a certain gum, or combinations of certain gums, also for improvements in dissolving the aforesaid gums, and in apparatus or machinery to be used for the purposes above-mentioned."—7th.

Robert Wilson, Low Moor Iron Works, Bradford, York, engineer,—"Certain improvements in steam-engines and boilers, and methods of preventing accidents in working the same."—7th.

Bennett Alfred Burton, John's-place, Southwark, engineer,—"Certain improvements in the manufacture of pipes, tiles, bricks, stairs, copings, and other like or similar articles, from plastic materials; also improvements in machinery to be employed therein."—7th.

John Edward Hawkins Payne, Great Queen-street, Middlesex, coach-lace manufacturer, and Henry William Currie, engineer,—"Improvements in the manufacture of coach-lace and other similar looped or cut-pile fabrics."—7th.

Charles James Anthony, Pittsburgh, America, machinist,—"Certain new and useful improvements in the means of treating unctuous animal matter."—7th.

William Henry Ritchie, Brixton, gentleman,—"Improvements in fire-arms."—7th.

John Houston, Nelson-square, surgeon,—"Improvements in obtaining motive power when steam and air are used."—7th.

James Steel, Horton, York, and Benjamin Emmerson, of the same place, overlooker,—"Improvements in power looms."—7th.

Gustave Francois Picault, Rue Dauphin, Paris, cutler,—"Improvements in apparatus for opening oysters."—7th.

Douglas Hebson, Liverpool, engineer,—"Improvements in steam-engines."—7th.

Henry Knight, Birmingham, mechanical engineer,—"Certain improvements in apparatus for printing, embossing, pressing, and perforating."—7th.

Stanhope Baynes Smith, of Birmingham, electro-plater and gilder,—"Improvements in depositing metals and in obtaining motive power, part of which improvements are applicable to certain other similar useful purposes."—7th.

Joseph Samuda, Parliament-street, Westminster, gentleman,—"Improvements in obtaining motive power, and the machinery or apparatus employed therein, which machinery or apparatus may be used for raising liquids."—(Communication.)—9th.

William Preddy, Taunton, Somerset, watchmaker,—"Improvements in watch-keys and other instruments, for winding up watches and other time-keepers."—12th.

Joseph Wade, denison of New York, gentleman,—"Improvements in engines for raising or forcing liquids."—(Communication.)—12th.

Joseph Burch, Craig Works, Macclesfield, engineer,—"Improvements in printing on cotton, woollen, silk, paper, and other fabrics and materials."—14th.

Peter William Barlow, Blackheath, civil engineer,—"Improvements in parts of the permanent ways of railways."—14th.

Michael John Harries, John-street, Commercial-road East, leather pipe maker,—"Improvements in the manufacture of packing for steam-engines, cylinders, and other purposes, part of which improvements are applicable to the manufacture of water-proof fabrics and leather."—14th.

IRISH PATENTS.

Sealed from 20*th May*, 1849, *to* 20*th June*, 1849.

Elijah Slack, Orchard-street, Renfrew, North Britain, gum manufacturer,—"Improvement or improvements in the preparation of materials to be used in the manufacture of textile fabrics."—May 28th.

John Bethel, Parliament-street, Westminster,—"Improvements in preserving animal and vegetable substances, and also stones, bricks, and articles made of clay, and chalk, and plaster, from decay."—June 1st.

Alexander Munkittrick, Manchester, Lancaster, merchant,—"An improved composition of matter, which is applicable as a substiute for oil, in the lubrication of machinery, and for other purposes."—(Being a communication.)—2d.

Joseph Deeley, Newport, Monmouth, engineer and iron-founder,—"Improvements in ovens and furnaces."—13th.

Robert Brett Schenck, late of New York, at present of Belfast, manufacturer,—"A machine for buffing and scutching flax, hemp, and other fibrous substances."—18th.

SCOTCH PATENTS.

Sealed from 22*d May*, 1849, *to* 22*d June*, 1849.

Moses Poole, Patent Office, London, gentleman,—"Improvements in apparatus for drawing fluids from the human or animal body."—May 23d.

William Newton, Office for Patents, Middlesex, civil engineer,—"Improvements in the jacquard machine."—28th.

Henry Vint, St. Mary's Lodge, Colchester, Essex, gentleman,—"Improvements in propelling ships and other vessels."—29th.

Malcolm Macfarlane, Thistle-street, Glasgow, North Britain, Coppersmith,—"Certain improvements in machinery or apparatus for the drying and finishing of woven fabrics."—29th.

Elijah Slack, Orchard-street, Renfrew, North Britain, gum manufacturer,—"An improvement or improvements in the preparation of materials to be used in the manufacture of textile fabrics."—31st.

Edward Buchler, London, merchant,—"Improvements in the manufacture of boots and shoes, also applicable to other fabrics."—June 5th.

Jacques Hulot, Rue St. Joseph, Paris, Republic of France, manufacturer of fabrics,—"Improvements in the manufacture of the fronts of shirts."—7th.

Thomas Greenwood, Goodman's-fields, London, sugar refiner, and Frederick Parker, New Gravel Lane, Shadwell, animal charcoal manufacturer,—"Improvements in filtering syrups and other liquors."—8th.

William Ironside Tait, Rugby, Warwick, printer and bookseller,—"An improved method or methods of producing outlines on paper, pasteboard, parchment, papier maché, and other like fabrics."—8th.

George Simpson, Buchanan-street, Glasgow, North Britain, civil and mining engineer,—"A certain improvement or improvements in the machinery, apparatus, or means of raising, lowering, supporting, moving, or transporting heavy bodies, such improvements being applicable to various useful purposes."—11th.

Joseph Harrison, Blackburn, Lancaster, machine maker,—"Certain improvements in and applicable to looms for weaving."—11th.

William Gratrix, Salford, Lancaster, bleacher and dyer,—"Certain improvements in the method or process of drying and finishing woven and other fabrics, and in the machinery or apparatus for performing the same; part of which improvements is applicable to stretching woven fabrics."—12th.

Osgood Field, London, merchant,—"Improvements in anchors."—14th.

Robert Nelson Collins, Oxford-court, Cannon-street, London, wholsesale druggist,—"Certain improved compounds, to be used for the prevention of injury to health under certain circumstances."—14th.

Francis Alton Calvert, Manchester, Lancaster, merchant,—"Certain improvements in machinery for cleaning and preparing cotton, wool, and other fibrous substances."—19th.

Charles Augustus Holm, Strand, engineer,—"Improvements in printing."—19th.

Thomas Harcourt Thompson, civil engineer, Blackheath-hill, Kent,—"Certain improvements in apparatus for preventing the rise of effluvium from drains, sewers, cesspools, and other places; and in apparatus and machinery for regulating the level of water in rivers, reservoirs, and canals."—22d.

DESIGNS FOR ARTICLES OF UTILITY.

Registered from 16*th May*, 1849, *to* 12*th June*, 1849.

May 16th,	No. 1890.	Charles Fletcher and Co., Birmingham,—"Cylinder for brick-making machine."
17th,	1891.	Henry Rowe Stevens, Newmarket,—"Smoke diffuser to cure smoky chimneys."
22d,	1892.	William Parkins, Oxford-street,—"Doubly secure envelope."
—	1893.	Thomas Suttie, Greenock,—"Kitchen boiler."
24th,	1894.	Benjamin Levy, High Holborn,—"The Prince (an over-coat)."
—	1895.	William and George Ashford, Birmingham,—"Improved holder for whip-sticks and other similar articles."
—	1896.	John Pannell, Cowley, Middlesex,—"Calorifere for green-houses, conservatories," &c.
25th,	1897.	Wm. Blackmore Pine, Strand,—"The mimosa or flower cornet."
—	1898.	Wood and Co., Grove, Southwark,—"Cigar lip-guard."
—	1899.	Douglas Hebson, Liverpool,—"Rudder casing, and rudder for vessels which are intended to be steered at each end."
26th,	1900.	William Binion, Birmingham,—"Lamp for railway carriages."
29th,	1901.	Theodore de Marillac, Manchester,—"Oil-can spout."
—	1902.	Silas Allen and James Rait Beard, Birmingham and Manchester,—"Improvement in braces."
—	1903.	Charles Walker and Sons, Little Sutton-street, Clerkenwell, engineers,—"Hydrant and gas sluice-valve."
—	1904.	Benjamin Cook, jun., Birmingham,—"Ever-tight bedstead sacking."
30th,	1905.	Charlotte Henry, Islington,—"Anatomical stays."
31st,	1906.	John Guest, Bedford,—"Barley-cutting machine."
—	1907.	Halford and Joseph, Tipton,—"Coke oven."
—	1908.	Thomas H. Pindar, Cheltenham,—"Self-adjusting waistcoat."
—	1909.	William Taylor, Birmingham,—"Crushing roller."
June 1st,	1910.	M'Kean, Perkes, and Co., Liverpool,—"Iron house."
5th,	1911.	Thomas Thornton, Great Carter-lane,—"Steam escape."
—	1912.	Ransomes and May, Ipswich,—"Wrench or spanner."
6th,	1913.	George Stocker, Holborn,—"Knife and fork cleaning machine."
—	1914.	William Couch, Skinner-street,—"Revolving carpet brush."
—	1915.	Edward Russell Beedle, Workingham,—"Ventilating brick."
—	1916.	Charles Alfred Tordery, Cathedral Hotel,—"Parts of a stock."
—	1917.	Thomas De La Rue and Co., Bunhill-row,—"Envelope."
7th,	1918.	John Holmes, Norwich, agricultural machine manufacturer,—"Manure distributor."
—	1919.	John Holmes, Norwich, agricultural machine manufacturer,—"Self-adjusting horse hay rake."
9th,	1920.	Nathaniel Jones Amies, Manchester, braid manufacturer,—"A hollow braid spindle."
12th,	1921.	Richard Hervey, London-street, City,—"An oval chimney top."
—	1922.	James Macnaughton, Glasgow, mechanic,—"Spindle bearing."

TO READERS AND CORRESPONDENTS.

Mr. Harper, Manchester.—The subject has been gone over so frequently, that it would be difficult to say much more upon it. When an opportunity offers for practically illustrating it further, we shall not neglect it.

Mr. Vallance.—We shall probably make use of his communication next month.

F. H. P., Leeds.—The apparatus is simple and effective. We shall engrave it for next month.

A CHAPTER OF VARIETIES.

CONWAY AND BRITANNIA TUBULAR BRIDGES—STRODE'S SELF-LIGHTING GAS-BURNER—GLASGOW NATIONAL BANK—ALLDAY'S WIRE CEILING—BISHOPP'S DISC ENGINE—"TIMES" PRINTING MACHINERY—REMINGTON'S BRIDGE.

Whilst so much is continually being done in the various branches of inventive and constructive art, of which this Journal professes to take cognizance, it may be readily conceived that its pages are frequently found quite inadequate, in point of space, as a record of the more valuable and interesting results which swell the catalogue of our experiences. To clear off, then, or at least to reduce, our expanded list of notable occurrences, we may perhaps be excused for throwing together a few particulars of passing events, which mark the current of the time's improvement.

As the great practical wonder of the time in which we write, the tubular bridge of Mr. R. Stephenson claims the first place; for, whether considered in its character as a gigantic conception, or as a magnificent example of engineering construction, it stands equally prominent amidst all contemporary works. The peculiar circumstances of the case precluded the adoption of all known and experienced forms of bridges; hence arose an absolute necessity for originality—a necessity, indeed, which it is seldom the lot of an engineer to encounter.

When it was first proposed to carry a line of railway communication across the Menai Straits, Telford's suspension bridge was mentioned as a suitable medium of railway conveyance; but this idea was soon given up, from the utter incapacity of so light a fabric for the support of the heavy masses which railways enable us to convey. It was then resolved to substitute a cast-iron arched bridge, in two spans of 450 feet each, a large rock in the centre of the Straits being pitched upon as the foundation for the central pier. This scheme was abandoned owing to the determination of the Admiralty to have a clear height of 100 feet close to the piers—obviously impossible in this case. The tube principle then occurred to Mr. Stephenson, who, assisted by Mr. Fairbairn and Mr. Eaton Hodgkinson, has succeeded most completely in the execution of this novel project.

Although the scheme has always been spoken of in connection with the Menai Straits alone, it is to be understood that the river Conway offered a similar bar to the progress of the Chester and Holyhead Railway, and similar steps have been taken to cross it. In both situations the streams are deep and rapid, and subject to great variations by the action of the tide, and no centerings or substructures of any kind could be used in the erections. The Conway bridge, which was erected in March, 1848, has sufficiently tested the truth of the theory that prompted the adoption of the tubular principle; and the experience gathered in its execution has served, to a great extent, as a guide in the carrying out of the more extensive work at the Menai Straits, which, whilst we write, is being vigorously pushed on.

The section of tube finally pitched upon was rectangular, being, in fact, a huge hollow girder, having a series of cells at the top and bottom, which the experiments had shown to be so remarkably valuable in giving stiffness to the mass. It was originally intended to have formed a double tier of cells; but, to simplify the matter, a single tier was finally adopted. Each line of rails has a separate tube, the total length of each being 424 feet, having a clear open span of 400 feet. The central height of the tubes is 24 feet 6 inches, sloping off at the ends to 22 feet 6 inches, and having a regular width of 14 feet 8 inches throughout. The number of rivets in each tube is no fewer than 240,000. Weight of the entire mass, 1,300 tons. The tubes were put together on the banks of the river, in order that they might be at once floated to their position on pontoons, which, after mature consideration, were selected as the most suitable means of conveyance. Six pontoons were employed, three being placed at each end of the tube, beneath the platform supporting it. The piers being so built as to leave a solid shelf of stonework about 3 feet above high-water mark, the tube was floated to its destination, and then allowed to rest on the masonry, the receding of the tide allowing the pontoons to descend from the tube, leaving it quite free. The elevation to the top of the piers was then accomplished in a perfectly easy and simple manner by a hydrostatic pump placed on the top of each pier, and connected to two beams set in the ends of the tube, by an enormous chain passing down each side from the two ends of a cross-head carried by the pump-ram. The travel of the rams being no more than 6 feet, it became a matter for the deepest consideration as to how the immense weight was to be supported during the time the ram was lowered, and again attached for another lift. This difficulty was got over by Mr. Fairbairn, who made the links of the supporting chains of such a form, as of themselves alone to support the tube, whilst the strain of the rams was removed. The lower part of the top of each link was made with a square projecting shoulder, so that, when the chains were put together, the range of shoulders came in a line, and formed a bearing surface for the cross-head attached to the top of the ram of the pump. This cross-head was fitted with adjustable clips, so as to be attachable at pleasure to the shoulders of the links by means of an arrangement of right and left-hand screws. Lower down, upon the large girders carrying the pump, were a second set of clips, placed at such a height, that when the ram was at the top of its stroke, the distance between the two sets of clips was equal to twice the length of the travel of the pump, or to two sets of the links of the chain. Thus, so soon as the rams, through the intervention of the upper set of clips, had elevated the tube to the height of 6 feet, the lower clips came into action and supported the weight until the rams had descended, when their clips again came under a new series of shoulders, and in this manner the lifting action was carried on until the required height was attained.

To each end of the tube were fitted three strong cast-iron frames, having two stout transverse beams arranged so as to afford stiffness to the tube, and, at the same time, to receive the two cast-iron bearing beams, bolted to the inside of the frames, to receive the suspending chains. Six additional transverse beams were inserted, to carry a longitudinal trough, placed on each side, to receive a range of gun-metal balls, as a support for the top of the tube. Corresponding troughs were placed above those in which the balls were placed, and on their upper surface were placed the ends of six cast-iron beams, connected by screwed rods to the tube. One end only of the tube being made moveable on its bed, to allow of the expansion and contraction of the metal, the bottom of that end was constructed to rest upon a series of rollers, 48 in number, to permit of an easy movement. Being in one length, and short—no more than 424 feet—the Conway tubes were comparatively easily managed, being raised at once to their beds on the tops of the piers on each bank; but those for the Menai Straits induced considerably more anxiety from their great length, the two greatest lengths being 472 feet each, and the others 274 feet, with a smaller one of 32 feet, the total length of each line of tube being 1,524 feet. It is in four spans, the two main ones extending from the central pier on the Britannia rock to those on each side of the Straits, leaving a clear space of 230 feet to be compassed by additional tubes from these piers to the shore. These tubes are now being put in their respective places; and before many weeks elapse, we may probably be able to record the successful result of a work with which the names of those engaged in it will ever be brilliantly associated.

In turning to another subject, we may introduce to our readers Mr. Strode's novel scheme for obtaining instantaneous gas-light. The plan, which is the production of Mr. Strode, of St. Martin's-le-Grand, London, is simply an adaptation of the zinc hydrogen, or Dobereiner's light. Our woodcuts will explain the arrangement. Fig. 1 is a complete view of the gas generator, and the additional apparatus on the top for producing the light. Fig. 2 is a view, double the size, of the light apparatus alone, as placed on the top of the generator. A, Is a common gas-burner for coal gas, which is conveyed to it by a flexible pipe, the supply to it being regulated by an ordinary tap beneath the jet, as represented in the sketch. B, Is a fine jet, which emits pure hydrogen gas from a glass reservoir below, as in the ordinary platina, or Dobereiner's light, the gas being generated by the immersion of a small Smee's battery, D, of amalgamated zinc and platinized silver, in dilute sulphuric acid. The coal gas being shut off, and the reservoir beneath full of hydrogen gas, the jet, B, is brought over so as to discharge hydrogen against the platina ball contained in C. Having ignited the hydrogen, the movement of the jet is reversed, and in so doing, the coal gas tap is opened, and its jet lit by the passage across it of the hydrogen light, whilst, at the same time, the latter is itself extinguished. This is effected by a concealed "brequet" movement, which connects the two taps together. The light is instantaneously obtained; and the apparatus, which is small, promises to be useful where a light is suddenly and frequently wanted. The sulphuric acid and water in the battery is not so soon saturated in this arrangement as in the old platina light, as the local action on the zinc is avoided for a long period. The contrivance is very ingenious; and if the disadvantages which our experience connects with the old Dobereiner's light can be removed, it is likely to come into extensive use: we should, however, suppose its price to be somewhat against it.

Fig. 1.

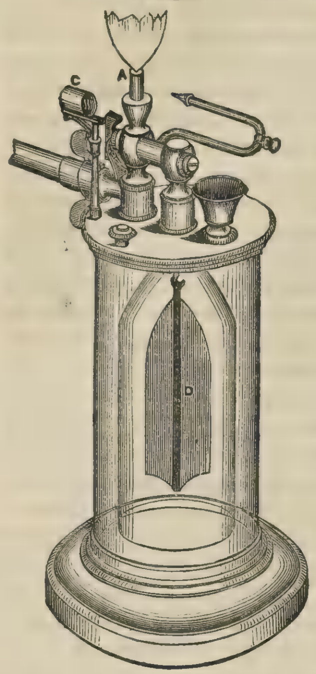
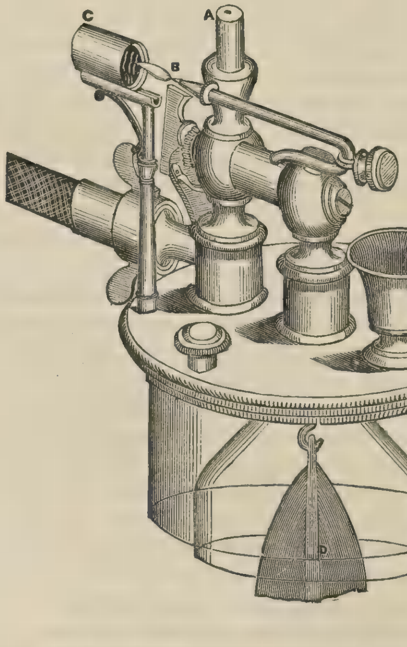


Fig. 2.



Turning nearer home, we have to note the completion, for business, of the new building for the National Bank, erected in Queen Street, in this city, as one of the most magnificent of our modern architectural examples. Unlike many others of its class, this building is fortunate in being surrounded by erections in character with it, although, on the other hand, it loses somewhat of its display in being too closely hedged in by the three sides of the square in which it stands, as well as by the narrowness and general gloom of Queen Street on the entrance side. The façade here is divided into two stories, the lower windows in which are enriched with Ionic pilasters, and the upper with Corinthian ones, whilst a rich entablature and cornice crowns the whole. The central portion of the front is in projection, having three-quarter columns in couples, the doorway being placed in the centre of the lower story. The lower windows are rusticated, and their keystones, as well as that of the doorway, are sculptured with heads emblematic of the chief of our British rivers. The national arms surmount the centre of the front, having on each side colossal figures of Peace and Commerce, the top line of wall being relieved from stiffness by a series of vases set at intervals. The interior presents many beauties in its decoration. The long and lofty vestibule of the Queen Street entrance has an arched ceiling, with two hemispherical coves, one of the domes of which contains a stained glass cupola, both being painted in blue, relieved with stars. The walls and arch are in imitation of Aberdeen granite, enriched with porphyry, and the cornice pilasters are of Bavarian jasper. A door at the inner end conducts the visitor to the telling-room, decorated in a gorgeous manner, the chief feature in it being the immense stained glass cupola. The supporting columns and pilasters are imitations of porphyry, the capitals and bases being white marble. The walls are in imitation of Sienna marble, whilst the doors and windows are surrounded by Dove marble.

The architect is John Gibson, Esq., of London, who also erected the fine square of shops and warehouses in which the bank is placed. The decorations are by Messrs. Bogle and Co. of this city, and the stained glass by Messrs. Ballantine and Allan of Edinburgh. The sculpture is by Mr. John Thomas, the sculptor of the colossal Egyptian lions at the entrance to the Britannia tubular bridge, as also of the decorative work of the New Houses of Parliament.

Whilst upon an architectural subject, we may mention a valuable improvement lately introduced in the construction of ceilings, by Messrs. Allday, of the Bordesley Wire Works, Birmingham. It consists in the employment of iron wire as the support of the plaster in place of laths. The ceiling of the Chester County Lunatic Asylum was constructed in this manner, with an excellent effect as regards beauty of appearance and smoothness of surface. It is made of straight thin wire, about four to the inch, with cross-bars 8 inches apart; and as the plaster passes through the numerous interstices, and the substance of the wire is very slight, it readily combines on the opposite side, forming a compact solid mass on both surfaces. As wire can be bent so easily to any shape, domes and ornamental ceilings of all classes may be readily made on this system, and much more economically than by the ordinary mode. Its fire-resisting qualities, with the great durability which it promises, will certainly bring the system quickly into use, especially for the peculiar purposes last mentioned.

During an inspection of Mr. Applegath's new vertical cylinder printing machine, a week or two ago, at the *Times* office, we were shown a new engine, which, at the time of our visit, had been at work, driving the printing machinery for a fortnight. It turned out to be a resuscitation of Davies* and Taylor's disc engine, about which so much was said, and by which so little was done, a few years ago. It is stated to be a 16-horse engine; and we believe the tests to which it has been put by Mr. Penn and Mr. Farey show that it will give off this amount of power. Looking down upon it from the gallery of the machine-room, at the bottom of which it stands, close to the wall, it presents a very remarkable appearance, its movement being very peculiar. To those who are acquainted with the engine as formerly made by the "Birmingham Disc Engine Company," our explanation of the general movement of the present machine will not be new, as the two are identical. A flat circular case, somewhat resembling the steam-chamber of the Cambrian engine, answers as the steam cylinder; it is divided across the angles by a fixed disc, acting as the abutments for the steam pressure. The case is fixed up vertically, its section in this position having some resemblance to an erect hour-glass, the two sides sloping inwards from the periphery to the centre, where there is a spherical joint for connecting the piston with the end of a rotating connecting-rod. Steam being admitted by ports on each side of the central division, a rotato-vibratory movement is given to the piston, and this is converted into a pure circular movement by the action of the central connecting-rod, whose opposite end is jointed to a crank on a shaft, the axial line of which coincides with that of the piston. The main modification introduced by Mr. Bishopp appears to be the fitting into the inner sides of the steam-case, against which the piston moves, of a series of radial slips or packing pieces of brass, pressed forward by springs. These are placed at regular distances, and assist in preserving a steam-tight connection between the case and the piston as the latter rolls round its path. The engine was made by Messrs. Joseph Whitworth and Co. of Manchester, and in their hands it has certainly had the benefit of workmanship of the highest class. When it has worked for a few months longer, we may be able to discover whether or not Mr. Bishopp's improvements have led to any good result. If it succeeds, it has, in its present position, an excellent means of making itself known. At present it drives the old flat surface printing machines, employed in printing one side of the *Times*, and the single new vertical cylinder machine for the other. The latter machine seems to be doing its work well, with the exception of the defect of the dim streak pointed out by us some time ago.* Its regular speed of work is now from 9,600 to 10,000 per hour, and even the flat machines are doing 5,600.

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* To prevent the chance of an error, into which we were formerly led, it may be here stated, that the Mr. Davies, of the disc engine, is of Stoke Prior, Worcester, and not Mr. Isaiah Davies of Birmingham, the inventor of the rotatory engine, lately noticed in our pages.

Many of our readers will remember the introduction to public notice of a new timber bridge, invented by an American of the name of Remington, of Alabama, U. S., through the medium of an extraordinary, and certainly a most ill-advised letter, with the inventor's signature, which was copied from an American publication into the papers of the day. Amongst the multifarious gatherings which our annual fair has brought together is to be seen an example of this bridge, which has been erected on the verge of the Green for public exhibition. It is entirely of timber, consisting merely of a row of five stringers passed from one abutment to another, and carrying a 4-feet roadway of thin planks set diagonally. The span is, we believe, 100 feet, and the length of stringer is obtained by joining timber, end to end with pieces of hoop-iron riveted to the faces of each piece. The section of stringer employed is a square of 3 inches at the ends, tapering off towards the middle to 1 inch. The first bridge of the kind erected in this country was one for Mr. Tyler, at the Surrey Zoological Gardens, for foot passengers; and, shortly afterwards, a carriage bridge was put up for Earl Talbot, at Ingestre, in Staffordshire, for an accommodation road. Since that period, several have been constructed; and Mr. Scott, by whom the model bridge here has been erected, states that he is prepared to carry out the principle for spans of any length.

The object contemplated by the inventor has been the adaptation of a chain, as it were, of timber, in such a way as to expose it to a simple tensional strain in the direction of its length, thus securing the most advantageous application of its cohesive strength. As the timbers are so light, he has, to a certain extent, succeeded in practising his theory; but not being so flexible as a chain would be under similar circumstances, although an approximation to the catenary curve is obtained, the natural stiffness of the wood prevents the perfect adjustment of its substance to the action of the load in transit, and, therefore, a considerable lateral strain arises.

The bridge we have seen, is carried by two piers or frames of timber, set at a considerable angle, in order the better to oppose the strain on the roadway; and, from the tops of these piers, the stringers curve considerably downwards to the centre, forming, as we have said, an approximation to the catenary curve. As an application of timber, the scheme is novel; yet it is difficult to see how the advantages claimed by the inventor are obtained. If we suppose the timber stringers to be represented by chains, or, better still, by the grass or hide ropes, used as bridges by various savage nations, we at once see, that although, by using timber, a light and strong support is gained, so long as the strain is in the true direction of the fibre, yet it is to be remembered that the same modification counteracts the catenary tendency, the obtainment of which can alone complete the necessary conditions under which the material can give out its maximum strength. If the stringers approach to the horizontal line, they are then simple girders, and their strength is absolutely nothing; again, if sufficiently loose and flexible to approach the catenary curve, the motion, as exemplified in the bridge on the Green, which we have crossed, is unpleasant and highly objectionable.

ON THE CONSTRUCTION OF LOCOMOTIVES.

(Continued from Page 78.)

The alterations in the construction of locomotives, already discussed, attain their highest value when outside cylinders are employed, because in that case the greatest extent of lowering of the boiler may be obtained. As a general opinion seems, however, to exist, that outside cylinder engines "will not do" for high speeds—which opinion is entertained by many, and very eminent engineers and engine-builders, and which, considering the very slight real foundation upon which it rests, may be considered a mere prejudice—it will not be out of place here to investigate this question.

The chief and most important objections to the employment of this class of engines with passenger or quick trains are these,—that they are more subject to oscillation, and that consequently there is danger in running them at high speeds, on account of the unsteadiness of their motion; that the wear upon them is very great, and their effect upon the permanent way far more injurious than that of inside cylinder engines. These are certainly great faults, and such as are peculiarly worthy of consideration in an essay which professes to hint at means for reducing the resistance and loss of power due to oscillation and friction.

At first view, the charges seem well-grounded. In the one kind of engine, the two cylinders, being firmly bolted together, so as to form, as it were, only one solid mass, are hung in the most efficient manner possible between the two frame-plates, between the points of support. Their centre of gravity lies in the centre line of the engine; they are, therefore, during the motion of the engine, not subject or exposed to any impulse or force, which, acting upon them alone, independently of the other parts, might impart to them a peculiar oscillation that could not fail to react injuriously upon the frame.

In the other class, each cylinder is kept separate, overhangs the frame and the base of the engine, and is attached to the frame on one side only; the two cylinders not being so united together as to act like one mass, each one has its own centre of gravity independent of the other, which lies beyond the base of the engine, and it is supported by short bolts attaching it to the frame. The oscillatory motion of the engine at high speeds is, of course, communicated to the cylinders, the weight of which, owing to the position of the centres of gravity, and their slight attachments, tends rather to increase the oscillation, each pulling at its own side of the engine, than to resist its effect and to steady the motion, as inside cylinders do. The injurious effects of this action are partially obviated in such engines where the cylinders are suspended within the extreme centres of the wheels, that is, behind the front axle, as several have lately been constructed.

But the chief remedy consists in so joining and fastening to one another the two cylinders, that, as was mentioned of the other class, they may, as regards their action on the framing, form but one solid mass, whose centre of gravity will lie within the points of support in the centre line of the engine.

This may be accomplished in various ways. The two cylinders may be bolted to one horizontal plate, stretching across the whole breadth of the engine, when they will resemble a double stationary horizontal engine upon one foundation-plate, this being securely fastened to the frame-plates; or they may be attached to two vertical plates, one at the top and one at the bottom of the cylinders, these plates being attached to the side-frames by strong angle irons. Where the cylinders lie higher than the crank-axle and incline downwards—the best position, if the driving wheels be fixed on the crank-axle—such transverse plates cannot be used; but then the cylinders may be equally firmly secured to one another by strong transverse stays between them, passing through the lower part of the smoke-box. In all engines, certainly, the side-frames are bound by transverse stays and plates; but this immediate connection of the cylinders is not attained thereby.

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* Page 248, vol. i.

I have experimented upon several engines, having their outside cylinders connected together transversely in this strong manner, at various speeds, up to 55 miles an hour, and have found them equally as steady as engines with inside cylinders of the same power and the same weight.

A firmer and more secure support to overhanging cylinders is also obtained, if the front axle runs in outside bearings, the other axles having, of necessity, inside bearings. Apart from this, the outside cylinder engine possesses very great advantages, both as regards safety and economy.

A straight axle is far less liable to fracture than a cranked axle. As there is greater security, so it can be made lighter, better proportioned to its duty, and it is far less expensive. There is, moreover, a great deal more friction about the cranked axle; and this excess of friction absorbs power, saved in the use of straight axles. The former requires, as a minimum, three bearings, and is generally made to run in four; the latter requires only two. The connecting-rod journals for the former are 5 or 6 inches, or more, in diameter, where 3 to 4 inches suffices for the latter.

In case of accidents to the connecting or piston-rod, &c., they are attended with less disastrous consequences to the engine with outside than with inside cylinders; and all repairs for the former are made more easily, in shorter time, and at less expense, owing to the disposition of the various parts being such, that they are more easily and conveniently got at, taken asunder, and replaced.

A great and favourite argument in favour of inside cylinders is, that being boxed up in the smoke-box and close together, they are kept at a very warm and even temperature, and consequently there is less loss from partial condensation, inevitable in exposed cylinders and long steam passages. The importance of this advantage, the existence of which is readily admitted, is more apparent than real. In constructing the details of any machine, the effect which the position of one part produces upon the others must be very carefully considered in all its bearings; and it is often found, that, in endeavouring to gain an advantage in one direction, the alteration is attended with such disadvantages, as completely to outweigh all the benefits derived. The cylinders lying immediately in the lower part of the smoke-box, the joints, screws, bolts, and other parts of the steam-chest are subject to constant injury from the particles of hot coke and dust falling, and the condensed steam dripping upon them. The amount of this injury is well known in the repairing-shops. A nut can seldom be taken off—and steam-chests must occasionally be opened, or steam and other pipes be new jointed—without stripping the thread, or breaking the bolt. Sometimes the cylinders are protected from this action, being partitioned off from the top part of the smoke-box by a covering plate. But then they are very little influenced by the heat escaping from the furnace up the chimney, and are not kept much warmer than outside cylinders when well covered in and protected by felt or wood. And it must be remembered, that to reduce still more the effect of this boasted advantage, the top and bottom covers of both kinds of cylinders are equally and unavoidably exposed to the action of the atmosphere.

The comparison between the two engines may be shortly summed up thus:—What is gained in inside cylinder engines by the smaller lateral oscillation, is lost by the naturally high position of the centre of gravity, making the engine top-heavy; the advantage of warm cylinders is counterbalanced by the injuries to which their position exposes them; the necessity of heavy, very expensive, and less trustworthy cranked axles; the crowding of the working parts into an inconveniently small space, out of view of the engine-driver; by forbidding the use of large driving wheels for high speeds, the velocity of the piston is increased, and, above all, a greater amount of friction is induced. Friction causes wear and resistance; resistance absorbs power; and power and fuel, *cœteris paribus*, go hand in hand. Therefore, reducing friction implies economy in repairs and in fuel; or, where the same amount of power is developed, its profitable effect may be increased.

The many advantages of outside cylinders are generally admitted, and the disadvantages are not without a remedy, as has been shown. Thus altered, even without the improvements or alterations suggested in this paper, the outside cylinder engine is the most economical, both as to first cost and as to the expenses of repairs; is equally safe; and having less resistance from friction, the proportion of power profitably employed is greater.

At this part of our paper, treating of the general principle of construction in the skeleton of the locomotive, a question may be raised as to the most judicious arrangement of the wheels. This question is not easily solved, such very contradictory and opposite conditions must be satisfied, Safety and steadiness of motion, being also economy of power, are attained, when the whole weight hangs between the extreme points of support, *i.e.* with a maximum distance between the extreme centres of the wheels. At the same time, to secure an easy passage with the least strain and friction of the wheels against the sides of rails through sharp curves, and through sidings and crossings, demands a minimum distance between the extreme centres. In luggage engines, power alone is required; the speed being low, there is but little oscillation; and such engines have been advantageously constructed with only four coupled wheels, and outside cylinders—the best arrangement for making the whole weight of the engine available as tractive power—as in several heavy engines by Mr. Fairbairn on the Manchester and Leeds Railway.

In passenger engines, built according to the construction recommended above, with the entire engine supported between the extreme centres, the distance between them is so great (about 16 feet with 10 feet boiler tubes), that for the sake of safety, it may be proposed to use eight wheels, the two front axles being placed close together, as in Crampton's and in the Great Western engines. The very long straight line along the flanges of the wheels will, however, produce, in curves, considerable strain and friction against the sides of the rails. To avoid or reduce this, the propriety of placing the two front axles in a separate frame, carrying the front of the engine on a central pivot, round which the separate frame is moveable, for the sake of an easy adjustment of the wheels to the curve, may here be touched upon. The American engines and waggons are all constructed upon this plan, and it has been found to answer well.

There is another source of loss of power and of unnecessary friction in the ordinary engine, too important to be here passed over. Every engine is supplied with two force pumps; one is generally sufficient, but as pumps are very liable to get out of order, two are almost invariably furnished. The old plan of working the pumps, and one still much used, is from the cross head of the piston-rod, the diameter of the plunger being small, and moving with the same velocity as the piston. A great improvement upon this plan is to work them from the eccentrics on the crank-axle, with a short stroke, the diameter of the plunger being proportionably increased. As the velocity of the plunger is now smaller, the action of the pump is rendered more effectual.

Calculating the amount of time that the pumps are employed in feeding the boiler during a trip, the plungers will be found to be worked uselessly or unnecessarily for more than one-half the time, and the power employed to work them during that time is of course wasted. Unfortunately this waste generally takes place when the engine requires the utmost extent of its power for the propulsion of the train, as at starting and in ascending inclines. If at such times the action of the pump could be interrupted, there would then be a saving of power, and a reducing of friction and wear. Two ways of effecting this object are now proposed. The working gear of the pumps may be easily constructed, so that the plunger can be thrown out of gear when necessary; or, the pumps may be made entirely independent of the working gear of the engine. How? By supplying two steam-pumps, or only one, as seems convenient, instead of the usual force-pump. The idea of using auxiliary steam-pumps, instead of the ordinary hand-pumps, is not new. For several years past it has been adopted on many of the continental railways; and lately also on some engines by Mr. Stephenson, and Messrs. Wilson & Co. of Leeds. Experience has proved to me, that these pumps can be effectually used during the running of the engine, instead of the usual pumps. One beauty of this arrangement is the delicate manner in which the power applied can be proportioned to the effect to be obtained. On the quantity of water to be admitted into the boiler depends the amount of steam let into the small cylinder, which can be regulated by the steam-cock; whereas, in the ordinary pump, the same power is always applied to the plunger, the quantity of water being regulated merely by the water-cock on the tender. The amount of steam necessary for working these little pumping engines is but trifling; the steam continually wasting by blowing off at the safety-valve, will go a long way towards the required quantity.

One more circumstance remains to be noticed, the effect of which, in causing great straining and unnecessary wear, has been lost sight of in but too many cases, and chiefly in inside cylinder engines; this is the expansion of the boiler by the heat.

The injurious effect of the expansion is visible in two ways. Firstly,—The boiler is immoveably fixed to the frame by means of stays, bolts, and rivets; no provision being made to allow of the trifling sliding on its seat. Secondly,—By the bearings for different parts of the working gear being partly attached to the boiler. The amount of expansion may be trifling, but still it takes place to some extent, and its power is irresistible. It produces a straining upon the rivets and stays, whereby it is fastened to the frame; and a strain and great increase of friction on such parts of the working gear as are needlessly placed in contact with it; and it results in a slackening of joints, leaking at the heads of the affected rivets, an undue wear upon the machinery, and a loosening of the bearings. To obviate these evil effects, it is simply requisite to attach the boiler firmly to the frame at one end, at the fire-box, and arrange all the other fastenings so as to allow a sliding on its seat; to attach the cylinders to the frame-plates, instead of to the smoke-box plates, and the bearings of the working parts to transverse plates or stays, instead of to the boiler.

As it is the object of this paper to suggest means for diminishing the resistance due to oscillation and friction, for the purpose not only of economising power, but also of increasing the durability of the engine, and thus reducing the heavy expenses for repairs, it is not out of place to advert to an invention having the latter tendency, namely, Mr. Schiele's patent improvements in cocks and conical valves, mentioned in a former part of this Journal.*

Cocks are necessary evils on engines; expensive in the first outlay, difficult to keep in order, and easily injured, from the wear upon them being irregular. The nature of the improvements, and the data on which they are founded, are fully explained in the article referred to.

The peculiar application of this invention here alluded to, is to the regulator valves of locomotives. Various circumstances combine to render these valves liable to leakage, and to a difficulty of adjustment, whether the disc-form or the ordinary slide-valve is used. The varying pressure upon them is one. When an engine has been some time in use, the valve soon begins to leak; the steam then gathering, while the engine is at rest, in the steam-pipes, steam-chest, and cylinder, condenses there to the great injury of the slide-valves and pistons. Owing to the unequal amount of friction at the exterior and interior of the disc valve, its very form is the cause of its wearing irregularly, and of its growing leaky; at the same time it suggests the readiest remedy. Let the two plates, instead of being flat, receive the form of the friction-curve, the curved parts working upon one another, with the same openings as in the old form. From the nature of the curve, as explained in the article cited, the wear in every part of the rubbing surface is equal and regular; the pressure will always keep the joint between the two plates tight, tightening them up as they wear, whilst there is no chance of sticking.

Having been favoured with an examination of various parts of machinery to which this improvement has been applied, I am enabled to speak of its value from experience.

This closes the investigation into an improved disposition of the parts of the skeleton, as it were, of a locomotive. The main features to which attention has been directed, may be shortly recapitulated. They are—large driving wheels placed behind the fire-box; outside cylinders, strongly bound together by transverse plates or stays, and placed behind the fore wheels; a very low boiler, so placed, as to admit of sliding on its seat whilst it expands; the non-attachment of the parts of the machinery to the boiler; an intermediate crank-shaft, and the employment of steam-pumps, instead of the ordinary force-pumps. In the details of the engine, many and very great alterations will have to be made, if these suggestions are followed up with the greatest advantage; in no part perhaps more so, than in the frame.

The altered engine will not be either much cheaper, or, abstracting from the difference between the weight of a large and a small driving-wheel, much lighter than those now used—that is not the object of the improvements, as most of the railways are constructed for such heavy engines to go at high speeds. The object of the engine-builder must be to construct engines having the least possible oscillation at high speeds, and a minimum friction; both these circumstances insuring the highest useful effect, and a reduction of expenses for working and for repairs. It may be objected, that instead of a diminution of friction, another shaft has been added with additional friction, the intermediate crank-shaft. But, compared with inside cylinder engines, the rubbing surfaces of the axle of the driving-wheels and the crank-shaft will not be found of greater extent than with a cranked axle of the usual construction, or only insignificantly; and compared with both engines, inside and outside cylinders, the general advantages gained by this system, as detailed above, are so very great, as to make this additional friction upon the usual outside cylinder engines scarcely worth while taking into calculation in a comparison.

This paper not being a general treatise on the detailed construction of engines, it is not necessary to enter into a discussion as to the construction and mode of action of the furnace or fire-box and blast-pipe as the origin, the boiler as the seat or reservoir, and the slide-valve as the disseminator of the power. Although the slide-valve is the best adapted for locomotives, it is attended with many disadvantages, especially when used at the same time as an expansion-valve, as in all engines with the link motion, from the back pressure which it causes, and the too early opening of the eduction port; besides, from the great pressure upon it, it requires great power to drive it. The resistance of the blast-pipe also absorbs an important part of the power. In fact, Mr. Sewell, in his paper on the "Resistances to Railway Trains," in the new edition of Tredgold, "On the Steam Engine," page 60, states this resistance to absorb about one-fourth of the whole power developed in the engines of the Great Western Railway, at the speed of 61 miles per hour.

That the resistance due to the blast-pipe is very great, cannot be wondered at. In stationary engines, the proportion between the fire-grate and flue-surface is about 1 : 9; in locomotives, the relative quantity of steam to be generated is greater, that is, it must be generated quicker; and yet this proportion, which varies exceedingly in different engines, may average from about 1 : 70 to 1 : 80. The consumption of fuel, or the production of heat, must be artificially forced on, which can only be done by an artificial blast. The larger the area of the fire-grate in relation to the boiler, the less blast will be required. To convert a certain quantity of water into steam, or, in other words, to generate a certain quantity of steam of a given pressure, in a given time, a certain amount of fuel is required; and the quantity of air or oxygen necessary for its complete combustion will be the same, whether the fuel be heaped up on a small, or spread over a large grate. In the latter case, the surface along which the cold air can enter being larger, a greater number of particles of air can enter simultaneously; consequently, the speed with which they must pass through the bars to sustain complete combustion is smaller; but as the layer of fuel is also thinner, and the air, therefore, meets with less resistance and less friction among the particles of fuel, the force necessary to drive it through is naturally smaller. Thus a double advantage is gained by a large grate, a smaller weight being driven at a lower speed. This extension may be carried on, till, as in stationary engines, no blast is required.

In the locomotive engine there are limits beyond which the grate-surface cannot be enlarged, and, unfortunately, these limits are far within those at which the natural draught, without an artificial blast, would be sufficient, the breadth of the grate-surface being limited by the position of the side-frames. One cause of the advantage of small, light engines over heavy ones, or one reason why they can relatively transport heavier weights, may easily be deduced from these remarks. The proportion between the grate-surface and flue-surface can be so very much reduced—the quantity of steam used being smaller—that the loss from the blast-resistance is not near so great, and the economised power may be employed for the propulsion of the paying weight.

But in the engines as now generally used, the fire-box may be lengthened greatly beyond the usual limits; and the construction of engine here recommended, peculiarly admits of this lengthening. Moreover, the velocity of the piston is smaller with large than with small driving wheels, the speed of the engine remaining the same, and the blast-resistance increases with the velocity of the piston. Thus this improved form of locomotive involves in its construction two important principles, both tending, as far as the action of the blast-pipe is concerned, to a considerable economy of power. But the action of the slide-valve and of the blast-pipe is too important to be cursorily noticed at the end of a long essay, and may well claim a chapter to itself.

No new inventions or discoveries are contained in what is here advanced, nor was it intended to bring forward any. So many different systems of construction are proposed, so many alterations continually made, while the complaints about depreciation of railway stock continue unabated, and the heavy expenses of working and repairing the moving plant, and the enormous charges for maintenance of way are rather on the increase, in spite of all improvements, that no excuse is needed for forcing this subject again and again on the public attention, especially where principles can be advanced and suggestions made, having economy of power, reduction of wear, of resistance, of working and repairing expenses, for their object, these principles and suggestions being founded upon, and derived from actual, practical experience.

Placing the driving wheels behind the fire-box is Mr. Crampton's patent. The use of an intermediate crank-shaft has been patented by Mr. Adams, and successfully tried on a carriage engine on the Bristol and Exeter Railway, and in an engine by Mr. James Samuel on the Eastern Counties line.

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* Pages 50 and 82, vol. ii.

The combination of various systems, the employment of steam-pumps instead of ordinary force-pumps, and certain alterations in the construction of the frame, having for their object greater stiffness, doing away with the horn-plates, which are very expensive, and greater cheapness, are probably the only points here proposed for the first time.*

Bradford, July 1. T. Passavant.

ON THE PADDLES OF STEAMERS—THEIR FIGURE, DIP, THICKNESS, MATERIAL, AND NUMBER.†

By Thomas Ewbank, Esq., New York.

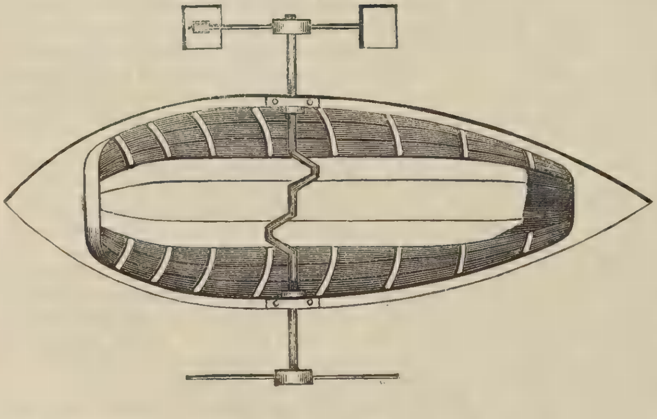
The world is awakening to the propulsion of steam-vessels, and nations are about to compete with each other in increasing their speed. Steamboat racing is too congenial with the age to be repressed; its spirit, so far from having been laid by legal exorcisms, or confined, as heretofore, to lake and river craft, has now seized the ocean for its theatre, and laughs outright at adjurations. Engineers and naval constructors, animated with the ambition of Olympian competitors, are preparing for a series of Atlantic chariot races, compared with which, the whole Naumachian spectacles of old were despicable puerilities.

Impressed with the interest of a contest unexampled in the annals of mechanical science, and one so characteristic of the progress of civilization, the following experiments were undertaken with a view of eliciting facts that seemed imperfectly known. Speculations on propelling abound. I am not aware that a series of experiments similar to these, limited and imperfect as they are, has been prosecuted. If any such are recorded, I have not met with them.

Experiments on variously-formed Paddles, made on the Harlem River, New York, in 1845 *and* 1848.

For this purpose, the boat, fig. 1, was employed. It was 12½ feet long, and 3½ feet across the middle. A wrought-iron shaft, 1 inch square, with a crank, extended across the gunwales, and turned in bearings bolted to them. The ends of the shaft stretched 14 inches over the sides of the boat. This prevented the wheels, which were secured on their extremities, from throwing as much water into the vessel as if they had been nearer, and afforded a better opportunity of observing the action of the blades. A person seated at one end of the boat, readily turned the wheels, in either direction, by alternately pushing from, and pulling towards him, two upright rods, which moved in joints at the bottom of the boat, and were connected to the cranks by horizontal rods or pitmen.

Fig. 1.



The wheels were very light, and of the simplest construction, as shown in fig. 2. Eight slender arms, of $\frac{5}{16}$ square iron, have their inner ends cast in the central piece. They extended 20 inches from the centre, and thus made a 40-inch wheel. To stiffen them, and transmit any strain upon one to the whole, they were braced tightly together by a wire wound round each arm, and retained by slight notches at the corners. The various blades or paddles were cut out of stout sheet iron. Square sockets, to slide over the arms, were riveted to them, by which means they were readily adjusted and secured at uniform distances from the axes. All were of the same area—49 inches.

To test the qualities of the boat, and get her into working trim, blades, 7 inches square, fig. 3, were fixed on the arms of both wheels, and several excursions, up and down the river, made with them. Their dip was 7 inches, or rather more, for their upper edges were half an inch below the surface. They were next removed from one wheel, and left on the other, as the standard by which to compare the effects of different shaped ones. They were distinguished as No. 1. Nearly all the rest were formed from them, *i. e.* by removing portions from one part, and adding them to others, as will be seen in the following diagrams. In this way there was no danger of making, through mistake, one set of blades of larger or of less superficial surface than others, since no calculation of their areas was required.

In all the figures, the paddles are supposed to sweep through the water in the position they are represented in, the lowest sides being those which descend lowest in the fluid.

Fig. 4, formed by cutting off the lower angles of fig. 3, and transferring the pieces to the upper ones, making a right-angled triangle, with sides 10 inches, and hypothenuse 14. (By mistake, the upper corners were cut away, so as to leave the area of these blades 48 square inches, instead of 49.) Eight of these were fixed on the wheel to compete with the same number of fig. 3, both having 7½ inches dip.

It will be obvious that, as both sets were attached to the same shaft, if one proved more efficient than the other, the boat would be turned from a straight course, and be inclined, more or less abruptly, to the weaker or less efficient set. The result was, that those marked fig. 3 overcame fig. 4; and though only in a small degree, yet quite sufficient to establish their superior effect on the vessel's progress. As we were not always out of the influence of tides and slight breezes, each experiment embraced excursions in various directions on the river. Once or twice the boat went straight as an arrow, but eventually the square paddles got the better of the triangular ones. These dipped into the water with little noise, and threw it off behind from their points.

Fig. 2.

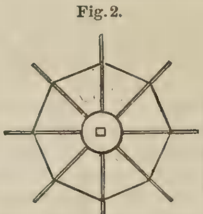


Fig. 3.

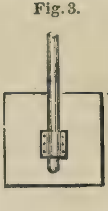


Fig. 4.

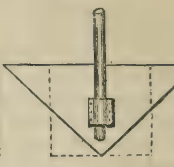
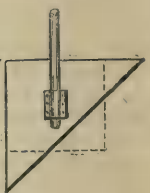


Fig. 5.



Most of the experiments were made in smooth water, and, except slight currents—aqueous and aerial—under the most favourable circumstances. Two persons occupied the boat, and the greatest care was exercised in preserving the shaft in a horizontal position. When results were doubtful, the experiments were repeated, and, generally, several times.

The same paddles, fig. 4, were next attached to the arms in the position represented, and distinguished as fig. 5, the upper side being, as in all other instances, 13 inches from the centre of the axis. Through repeated trials they overcame the test paddles, fig. 3, and in a rather more marked manner than fig. 3, surpassed fig. 4. They entered the water silently; but observers on shore thought they raised more water behind, but did not raise it as high as fig. 3. Their points were nearly 3 inches lower in the water than the lower edges of fig. 3. The boat described a circle of 400 feet, and another of 600.

The same blades were next tried as fig. 6. From the experiment, fig. 5, it was inferable that, if inverted, the effect of the blade on the boat would be augmented, as a larger portion would have a longer sweep through the water. Such was the fact, and to such a degree, that first two, and then four, were removed from the arms, when the remaining four were found equal to the eight of fig. 3. The plates were next raised, till their lower edges were on a level with those of No. 1. In that position, two inches of their upper extremities were above the surface of the river; but, notwithstanding, they had a decided advantage even then over the square ones.

Lastly, the same blades were turned into the position of fig. 7 (being fig. 4 reversed). The boat was turned on No. 1 under all circumstances, describing circles from 80 to 150 feet in diameter. Four of them equalled eight of No. 1. They were thought to throw off more water behind than their competitors, which, from the greater extent of their extremities, is probably true.

The next form tried was fig. 3, placed in the position of fig. 8. These turned the boat round against the test ones, in circles varying from 50 to 200 feet. We then tried six of them against the other eight, when there was little observable difference in the results. Four were found superior, but three were unequal to them. These, of course, entered the water without jarring, and threw it off at their points. Mr. B. thought they threw up more than fig. 3.

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* We may here correct one or two errors which have crept into the first part of this paper in our last number. At page 77, first line from top, for "not much resistance," read *not much difference;* in same column, fourteenth line from bottom, for "locomotion," read *locomotives;* and, in the second column, twelfth line from bottom, for "the eccentrics may be worked," read *the slide-valves may be worked.*

† From the *Franklin Journal.*

Fig. 6.

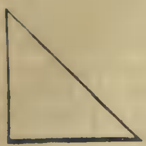


Fig. 7.

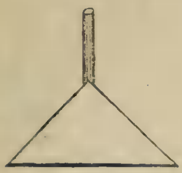


Fig. 8.

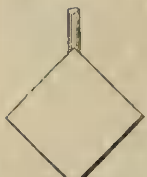


Fig. 9.

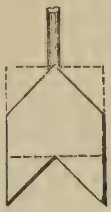


Fig. 9 were formed by removing the upper corners below, as in the figure. These seemed to have the advantage of fig. 8, but as light winds troubled us, we felt some hesitation in pronouncing them better. Four were superior to eight of No. 1. It was supposed that a slight accession of resistance to the lower ends, sweeping through the water, might be derived from opposing currents meeting in the forks, but we had no means to ascertain it, if it existed.

Fig. 10—cut out of plates eight inches square, with one-fourth (minus a superficial inch) removed, as shown in the figure. After several excursions, these were thought to exhibit a very slight advantage over fig. 3; but, from subsequent tests, they seemed to be balanced. We, on another day, reversed them, as in

Fig. 11, which had a decided preponderance over their competitors.—Six predominated slightly over the latter, and four were thought nearly equal to them. There was a difference of opinion on the last point—some thinking they were quite as effective as the opposing eight.

Fig. 10.

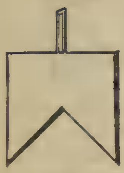


Fig. 11.

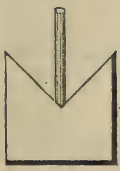


Fig. 12.

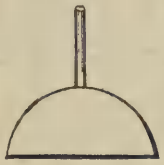


Fig. 13.

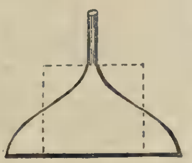


Fig. 12 was a semicircle. Mr. B. undertook to test these. They turned the boat in circles varying (from light winds and tides) from 30 to 150 feet. Four were thought sometimes equal, and sometimes superior, to eight of fig. 3. It is demonstrable that these blades are less effective, though in a very small degree, than those marked fig. 7, and, when reversed, more powerful than fig. 4.

Fig. 13—formed as in the figure, but not tried, as it was evident their value would be nearly that of fig. 7, probably a shade above them, but too minute to be detected, except in perfectly still water.

Fig. 14—a right-angled triangle, 7 inches across the top, and ending in a point nearly 14 inches below it. These were, as might have been anticipated, more effective than those of fig. 3. "Everything about them," observed Mr. B., "shows their superiority." They, of course, entered the water without jarring.

The same were attached to the arms in the position of fig. 15, and were unable to compete with fig. 3. The latter had a slight advantage over them.

They were next reversed, as fig. 16, when they proved effective as figs. 7 and 12—four being equally so as the eight opposed to them.

Fig. 14.

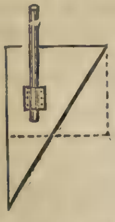


Fig. 15.

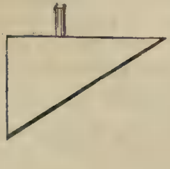


Fig. 16.

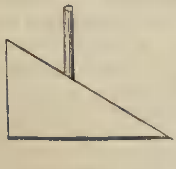
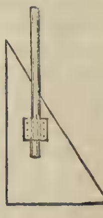


Fig. 17.



They were finally changed to fig. 17, when the boat was turned so rapidly, as to make it difficult, with a wide oar, to keep her in one direction. Four were removed, and then she described a circle in less than 50 feet. Two more were taken away, leaving only a couple to act against the eight on the other wheel, and to which they proved equal.

From these experiments, it appears that, with equal areas and equal dip, triangular blades may be rendered twice as effective as ordinary rectangular ones. This is made manifest by figs. 7, 12, and 16,—*four* of the former equalling eight of the latter. And this, too, while the propelling surface of the smaller number was only half that of the greater; for the four were as long in making a revolution as were the eight. Hence, the speed of a boat may be increased by diminishing the number of her paddles—a fact still further elucidated by fig. 17.

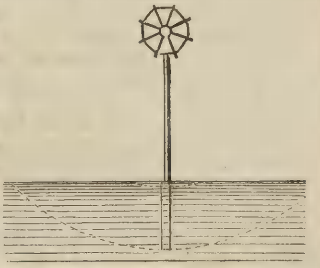
There can, I think, be little doubt, that the greater the velocity of a steamer's wheels, the fewer (within certain limits) should be the blades; and that, at the rate at which some of our boats go, the number might be reduced with advantage. Some have three, others four, and in more than one vessel, without any load on board, I have seen six submerged at each wheel. In these cases, is it not evident that each blade, on entering, plunges, not, as it ought, into water undisturbed, but into that which preceding ones have already broken up, and set in motion towards the stern? It would seem that one in the act of plunging, another sweeping under the shaft, and a third leaving the surface, are all that are necessary to be kept up; and that a greater number, as regards the speed of a boat, is positively injurious. Yet, under a vague idea of attaining a higher speed, the number of paddles has frequently been nearly doubled.

Snow, as every person knows, causes the wheels of land locomotives to slip upon, instead of rolling over, the rails. They revolve as usual, but their carriages make little progress; hence, much of the power spent on them is expended to no purpose. So it is with paddle wheels. A boat never progresses in the ratio of their revolutions, because of the yielding medium in which, and against which, they act. They slip always—a result inevitable when massive solids wade through fluids. The distance between the Atlantic steamers' docks, in Liverpool and New York, has been calculated at 3023 miles, but their paddles, in each trip, pass over a space varying from 5000 to 8000 miles.* In steamers unaided by sails, the disproportion is often greater. Now, can this be modified, by giving the paddles a better hold on the fluid they sweep through? The experiments, figs. 5, 6, 7, 8, 9, 11, 12, 14, 16, and 17, furnish replies to the interrogatory.

The moral of the foregoing experiments is this:—As the propelling power of a paddle is greatest at its lower or outer extremity, and diminishes to nothing at the surface, so its face should enlarge with the dip, and be nothing, or next to nothing, above. In fig. 18, the upper portion of the paddle barely touches the water, and only for the moment it is in the position shown. But suppose it were immersed to the upper curved line—say four or five inches—it would even then be no sooner under than above the surface again, so brief would be its immersion. The lower edge, in the meanwhile, would sweep along the extended curve there delineated.

Of what use, then, to make the upper part of a blade of equal extent with the lower? Why accumulate surface where it is of little avail, and withhold it from where it is most wanted? expending materials and power without any adequate return, if not at an absolute loss. The quantity of water carried over a wheel is certainly greater by ordinary, than it would be by triangular, paddles. The peculiar form and position of paddles are unphilosophical, if viewed simply as propellers. Embrace the same area in any other outline—in a circle, ellipse, square, pentagon, hexagon, octagon, or other polygonous figure, and the propelling properties would be increased, and the jar, arising from their striking the water, also diminished.

Fig. 18.



If the long parallelogram be preferred, because of the ready application of wooden planks, then is the principal sacrificed to an accessory—the greater to the less. If triangular, or other improved blades, require the adoption of plates of metal, would it be wise to reject them on that account? But of this by-and-by. We shall see that thick wooden blades ought to be condemned on account of defects inherent in them.

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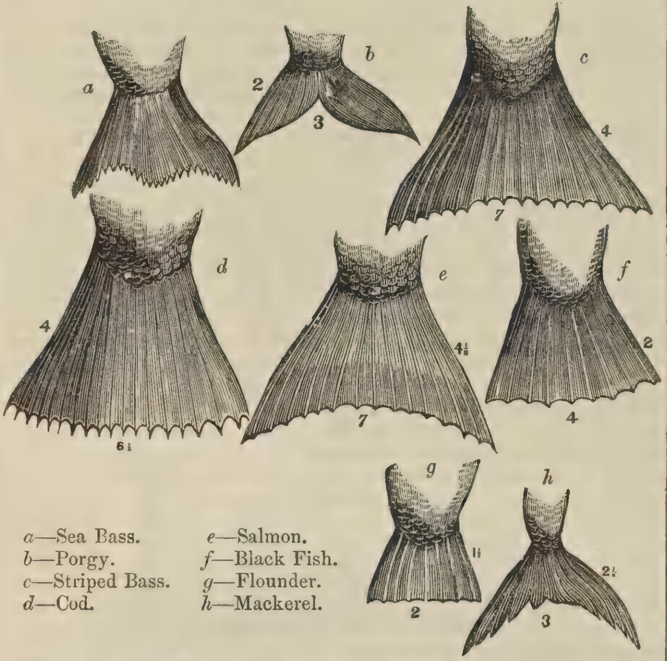
* The English steamer *Europa* came in on the 25th ult., after the remarkably short trip of eleven days. Her wheels are 32 feet in diameter, and taking their revolutions at the average of 17 per minute, her paddles swept over a space exceeding 5000 miles. The steam-ship *Northerner* has wheels 31 feet diameter. In running from New York to Charleston, 630 miles, they made 52,000 revolutions, in another trip, 51,000. The *Cherokee's* wheels are the same dimensions. In her first trip, to Savannah, a distance of 700 miles, they made 53,000 revolutions. The practice now is, to lessen the slip of marine carriage wheels, and make them approach nearer in effect to those used on land, by increasing their width, that is, the length of their paddles. Hence, those of the *Atlantic*, one of the large Liverpool Liners now building, are to be 12½ feet long; but for the difficulty of entering the English docks, they would have been 14 feet. Those of the *Hermann* and *Washington*, of the Bremen Line, are respectively 8 feet and 7½ feet; while the *Franklin*, preparing for the same line, has them 12 feet. The English mail boats of recent build, the *Europa* and her three associates, have paddles between 8 and 9 feet.

But what is this expansion of the lower part of a paddle, and contraction above, but Nature's own plan? In the tails and fins of fishes, in wings of birds and insects, and especially in the palmipeds, she has nowhere sanctioned a rectangular propeller. All are inclined to equilateral, scalenous, or isosceletic triangles, or are made up of them. Nor does she ever unite the levers that work them to their sides. The junction is invariably at an angle, and the reason is apparent—that the largest surface may have the longest sweep.

With this view, the bodies of fishes taper down to meet the blades, retaining only sufficient muscle to work them. The other day, I had an opportunity of sketching the following. I am ashamed to acknowledge that, till then, I was ignorant of the exact forms of these natural propellers, although most of them had passed under my observation on a thousand occasions. Too many of us spend no more thought on the infinitely curious and instructive mechanisms submitted by the Creator to our inspection daily, than does the ox on the vegetable glories he feeds on. The sentiment applies not more to religious, than to physical truths. "Light shineth in darkness, and the darkness comprehendeth it not." We grope, as if blind, for that which is patent before us.



a—Sea Bass.
b—Porgy.
c—Striped Bass.
d—Cod.
e—Salmon.
f—Black Fish.
g—Flounder.
h—Mackerel.

The general outlines and proportions are given in the preceding figures; the dimensions, of course, vary with the age and growth of individuals. The figures denote the width and length of the expanded tails, the latter being taken from the termination of the body, as shown by the curves, which reach more or less into the tails, *i. e.* to strengthen them where strength is most required.

I confess I had no idea of meeting with figures so closely allied to the artificial ones which I had found most effectual as propellers. With the exception of the first two, the whole approach to equilateral triangles.

In the absence of a more extended acquaintance with the minuter aqueous and subaqueous organisms, the nearest of natural analogues to steam-vessels seem to be the principal swimming-birds. These glide through two elements at once. Their long and heavy bodies, adapted to float gracefully on water, are provided with organs of propulsion, placed far behind their common centres of gravity, the cause that makes them such awkward travellers on land. When a gale blows in the direction they wish to pursue, like human navigators, they take advantage of it; they spread their wings to catch it, and are driven onward then, as steamers are, by both wind and paddles.

The reciprocating action, and the expanding and collapsing features of their aqueous organs of progression, are supposed to be unsuited to the magnitude, materials, and velocity of artificial ones. Perhaps they are; but may not their contour be perfectly applicable, since, when open and in action, the circumstances of the two bodies propelled—the bird and the boat—are not essentially dissimilar? Now, there is a marked adhesion to the triangular form in the webbed feet of birds; showing that, in the judgment of the Creator, such an outline is the best for the purposes of their propulsion. Nor does it appear that this outline has, in any material way, been modified to meet other exigencies. In the feet of water-fowl it is almost identical with the tail of the sea bass. The legs, or rods, that wield these ornithologic paddles, are invariably united to them at their points or angles, and clearly for the reason already stated.

Fig. 19 represents the foot of a petrel. It is a type of all the swimming-birds' propellers. Few, except professional naturalists, could distinguish between it and the same organ in geese, ducks, gulls, swans, the albatross, cormorant, diver, flamingo, &c., &c. Although natural paddles are submerged when at work, and those of our wheels emerge into air, to repeat their strokes, I doubt if a more efficient form could be given to the latter than the above. The cuspated extremity would obviate the jar consequent on straight-edged blades striking the water.

Fig. 19.

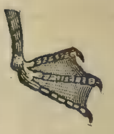
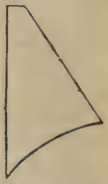


Fig. 20.



If I had a new boat to fit propellers to, they should resemble figs. 6, 7, or 17; or I would rather make them like half the foot of a swimming-bird, as fig. 20, in the margin,—the perpendicular sides being next the vessel, that the greatest strain might be nearest to the power. Such blades would not be raised out of the sea by a vessel's rolling, nor, when submerged, be subject to excessive strainings, as common ones are. They would produce no concussion, or but little, on dipping, and would be twice as effective as the same area employed in the current form and fashion.

If the principle were required to be adopted in the present paddles, it could be done at a trifling cost. I would remove portions from the upper sides, and attach them below, somewhat after the manner shown at figs. 21, 22, 23, and 24.

Fig. 21.

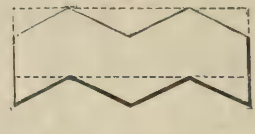


Fig. 22.

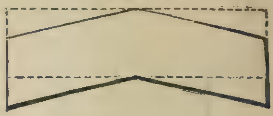


Fig. 23.

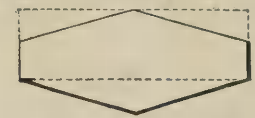
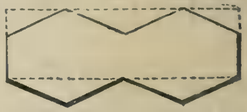


Fig. 24.



The portions might be removed by curved instead of straight lines.

If I used blades similar to fig. 7, I would vandyke their lower edges as at 21, point them as at 23, or fork them as at 22.

We shall give the conclusion of Mr. Ewbank's investigation in our next.

WALKER'S HYDRANT AND GAS SLUICE-VALVE.

The valves usually employed for the regulation of the flow of gas in gas-works, are of the flat sluice description, having a rod attached to the ball, passing through a stuffing-box on the cover of the valve-case. In some cases, a nut is carried by the back of the valve, so that the latter can be raised or lowered by a screw-spindle passing through a stuffing-box on the cover of the valve-case to a handle outside. The objection to this plan is, that the gas being loaded with tar, ammonia, and other matters, in its passage, chokes up, and sometimes strips the threads of the screw, rendering it immoveable. Hence the use of external racks; but they are objectionable on the ground of the great space taken up by them, and not unfrequently the teeth are broken by clumsy men sent to remove them in a hurry. When buried in the earth, the valve can neither be set horizontal nor vertical, but must lie on its edges, on account of the pinion movement; and it is necessary to enclose it in a box to prevent contact with the earth.

As an improvement upon these forms, Messrs. Charles Walker and Sons, of Little Sutton Street, Clerkenwell, London, have introduced a modified arrangement, figured in our engravings. Fig. 1 is a back elevation, and fig. 2 a side view of the new valve. A, Is the valve, the face of which is fitted tight upon the facing, B. C, Is the chamber for the reception of the back of the valve when it is drawn up. At the back of the valve is a box, E, containing an internal screw, as represented in the sectioned portion of fig. 1. In this works a screw, F, formed on the spindle, G, which has a collar at H, working in a stuffing-box, I, to retain it longitudinally, and for the prevention of leakage. Another stuffing-box is fitted at K, with a brass ring round the spindle to prevent rapid wear, and also to hinder the entrance of any fluid or deposit to the screw chamber. At the back of the valve are formed two wedges, L L, which fit into two corresponding wedges in the valve-case, to keep the valve close to its facing when down. The extent of opening of the valve-way is exactly pointed out by the toothed index-plate, M, worked by the endless screw, N, at the top of the actuating spindle.

Fig. 1.

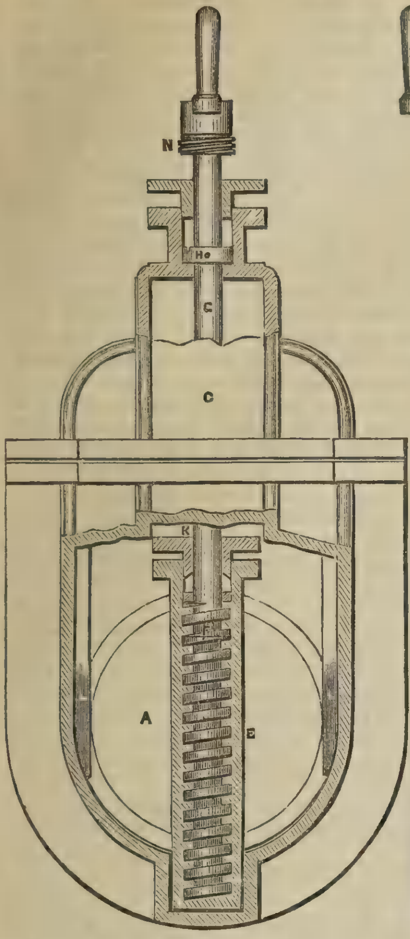
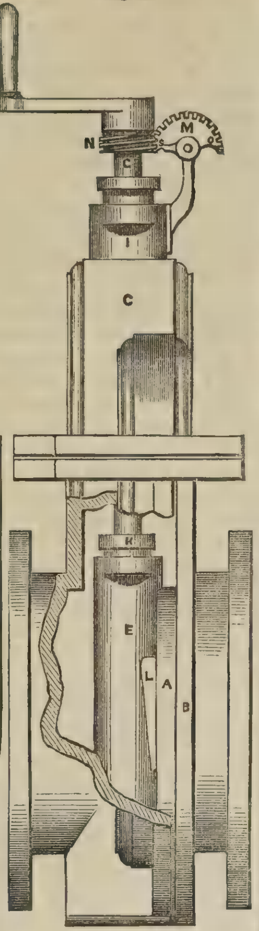


Fig. 2.



When the valve is fixed up, the chamber, E, is filled with thick oil; and if it stands closed for any length of time, and tar or other deposit collects, on raising the valve the gland will slide it off, and the spindle will be well oiled by passing through the case. As a means of supplying oil to the chamber, as well as to permit of the ingress and egress of air, a hole is bored down the axis of the spindle.

For thick and corrosive fluids this valve appears to be peculiarly applicable, as the constant working, which causes such rapid wear in the old valves, will, in this arrangement, oil the rubbing surfaces, and preserve them in good working order.

THE THERMOMETER AND THE PHENOMENA OF HEAT.

No. I.

The principle of heat, in the language of philosophy, is termed caloric; and the quantity of apparent heat which any body contains is called its temperature. Caloric is classed, with light and electricity, amongst the imponderable agents of nature—that is, those which have no perceptible weight. Two hypotheses have been put forward with respect to its nature. Newton considered it as a fluid of inappreciable tenuity, and subtle penetrating quality, the particles whereof are endowed with definite powers of repulsion. In the other hypothesis, the phenomena of heat are asserted to be owing to a vibratory motion caused by caloric in the particles of ponderable matter; and that, whatever may be the real nature of caloric, it is only made known to us as the cause of an affection in the material things around us, which reveals itself, in the first place, by a particular sensation, and, further, by altering the dimensions and structure of bodies. It is invisible, has no weight, is highly elastic, with a great tendency to expand, and seems to be of a very repulsive nature. The chief sources of heat are the sun, the earth, electricity, some mechanical actions, such as compression, percussion, friction, and almost every kind of chemical action. Caloric has the property of expanding and dilating everything subjected to its influence, so that the more heat a body possesses the greater is its size. Hence, when we say that cold contracts a body, we only mean that it would be of larger bulk if it contained more heat. In this way it seems to be the grand antagonist of attraction, introducing a repulsive force amongst the particles of material things, and lessening their cohesion. When this has proceeded to a certain extent, a solid becomes a liquid; and if a further charge of heat be thrown into it, the liquid becomes gaseous. It is only to a few bodies, however, that we have the power of applying such a range of heat as will make them take successively these three forms. A low degree of cold shows mercury and water as solids; whilst at a moderate temperature they are liquid, and at a high temperature gaseous. Several of the gases have been converted into liquids; and, recently, some of them have been seen as solids. There is no reason, indeed, for supposing that any solid, however refractory, is absolutely infusible; or that any vapour, however rare, is essentially incapable of solidification. We may consider that the range of temperature to which our senses are regulated is a very limited one; that the substances of the globe have been curiously adapted to our use, by being adjusted to that range, and endowed with different capacities for heat, whereby we have bodies of varied density—solid, liquid, and gaseous; and that both heat and cold transcend by infinite degrees the narrow bounds of human experience. It is this property of expansion that furnishes the means of measuring the quantities of caloric that different bodies respectively contain; in other words, of ascertaining their several temperatures. The instrument employed to measure a moderate degree of heat is termed a Thermometer (θερμος, heat, μετρον, a measure); that to measure a higher degree a Pyrometer (πυρ, fire.) The ordinary thermometer consists of a glass tube exhausted of its air, and having its lower end blown into a bulb holding mercury. As heat is applied, the mercury expands and rises in the tube, the amount of elevation being, in this way, an index to the temperature. A graduated scale serves to measure the elevation attained.

The germ of our thermometer was invented, in 1590, by Sanctorio, an Italian physician, who employed an instrument containing air to ascertain the heat of patients suffering from fever. Alcohol was substituted for air in 1655; and, in consequence of its not being liable to freeze, alcohol is still employed in cases where mercury would become solid. But mercury, in ordinary temperatures, is to be preferred, in consequence of its expanding much more equally with equal accessions of temperature.

It is much to be regretted that the nations of Europe graduate their thermometers in a different manner, since a comparison of observations can only be made by a troublesome calculation. Experiment having proved that water freezes and boils at two points, which are the same for every place at the same height above the level of the sea, whatever may be the latitude, the scales of some thermometers divide the interval between the two points into a certain number of equal parts, beginning to number at the lowest. Thus, the Centigrade thermometer (used in France), and Reaumur's (used in Germany), place the freezing temperature of water at zero (0°); whilst the boiling temperature in the former is figured 100°, and in the latter 80°. For temperatures below zero these thermometers begin a new series of numbers, preceded by the minus sign (—), and regularly increasing as the temperature decreases. The English employ Fahrenheit's marking of the scale, on which 32° represents the freezing point, and 212° the boiling point. The Russians use De Lisle's scale, on which these temperatures are marked 150° and 0°. The following gives a summary of the four scales:—

	Reau.		Cent.		Fahr.		De L.
Boiling point,...........	80°	......	100°	......	212°	......	0°
Freezing point,....	0°	......	0°	......	32°	......	150°
Difference,..............	80°	......	100°	......	180°	......	150°
So that	4°	=	5°	=	9°	=	7½°

The following rules for converting the degrees of some of these scales into degrees of others may be useful:—

Centigrade into Reaumur.—Subtract a fifth.

Reaumur into Centigrade.—Add a fourth.

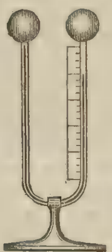
Fahrenheit into Centigrade.—If the reading is above 32°, subtract that number, multiply the remainder by 5, and divide by 9. If the reading is below 32°, take the number of degrees in question from 32, multiply the difference by 5, and divide by 9: to the result must be prefixed the minus (—) sign.

Fahrenheit into Reaumur.—When the reading is above 32°, subtract that number, multiply the remainder by 4, and divide by 9; if below 32°, subtract the number of degrees in question from 32, multiply the difference by 4, and divide by 9, affixing the minus (—) sign.

Centigrade into Fahrenheit.—Double the Centigrade degrees, subtract one-tenth from the product, adding 32° if the temperature is above the freezing point, or subtracting the product from 32° if below.

Reaumur into Fahrenheit.—If the reading is above the freezing point, subtract 32°, multiply the difference by 4, and divide the product by 9; if below the freezing point, take the reading from 32°, and proceed as before.

A good deal of ingenuity has been expended in forming what are termed Register Thermometers, instruments which are designed to mark, during the absence of the observer, the highest and lowest points to which the mercury has attained. The metal thermometer, invented by Breguet, is sometimes used when extremely nice variations of temperature are in question. It consists of a very thin spiral or circular spring, composed of two metals, having different powers of expansion (platina and silver are generally used), soldered together. The movement of the spring acts upon wheels, which communicate with a pointer on a dial-plate.



The differential thermometer is a species of the air thermometer, being simple and delicate in its indications. It is extensively employed where minute changes of temperature are in question; and, being susceptible of several modifications, it is of great use in meteorological researches. The woodcut in the margin shows its usual form. It consists of a tube, hermetically sealed, and bent into the form of the letter U, having a hollow ball filled with air at each extremity. That branch to which the scale is applied contains some coloured liquid, sulphuric acid tinged with carmine being generally used. If both balls are of the same temperature, the liquid will remain stationary; but if the ball at the top of the stem holding the liquid be warmed, the air, by its expansion, will depress the liquid; whilst, if that ball be cooled, the air, by its contraction, will allow the liquid to ascend, from the superior elasticity of the air in the opposite ball. The fall or rise of the liquid, therefore, depends upon and indicates the difference of temperature between any two media in which the balls are placed.

In order to measure very high degrees, Wedgwood invented a pyrometer of clay, the contraction of which, by the driving off of the moisture, roughly indicates the temperature. There is also the air pyrometer, an instrument consisting of a hollow sphere of platinum, fitted with an escape tube, by means of which M. Pouillet has determined, in degrees of the ordinary thermometer, the point of fusion of several substances. The following table gives the result of some of his experiments:—

	Deg. of Fahr.
English Wrought-Iron fuses at	2912
French Cast-Iron,	2732
Steel,	2372 to 2552
Pure Gold,	2182
Gold Money Alloy,	2150
Pure Silver,	1832
Bronze,	1652
Antimony	812
Zinc,	670
Lead,	632
Bismuth,	593
Tin,	452

Expansion.—The amount of expansion of all gases and vapours, when heated from 32° to 212°, is very nearly the same. Liquids expand in very different degrees. It is a consequence of the expanding power of heat, that when a portion of a liquid or fluid has become warmer than the rest, it should ascend, because it has become specifically lighter. When a vessel of cold water is placed on the fire, the lowest stratum first becomes warm. It consequently ascends, and a colder stratum takes its place; and this process is continued as long as the water is subjected to heat. On a summer day, the air which is in contact with the hot ground may be seen to be affected with a tremulous motion. This phenomenon proceeds from its having become warm, and being in the act of mounting upwards, air of greater specific gravity displacing it. When this displacement takes place on a large scale, winds are occasioned. To show the immense expansion which heat occasions in bodies, we may mention, that water converted into steam occupies a space equal to 1,728 times its former bulk. The law as to expansion by heat is subject, in certain bodies, to a singular modification. At a certain point, these bodies are at their maximum of density, and they increase in bulk, both by depriving them of caloric, and by giving them caloric. For instance, water is at its maximum of density, according to some observers, at 42°5 Fahr., and at 10° above, and 10° below this point, it possesses the same bulk. Water also expands in freezing, and with so much force that it will burst vessels and metal pipes in which it may be confined. This anomalous phenomenon is supposed to be owing to the process of crystallization demanding a new arrangement of the particles, which causes in some directions large interstices. An alloy of 4 parts of bismuth, 1 of lead, and 1 of tin, also expands in freezing, its maximum of density as a solid being at 111°. It must be observed that similar increments of bulk in solids are not produced at every degree of temperature by similar increments of heat. In fact, bodies expand more in high than in low temperatures by equal increments of caloric, because the cohesive force of their particles is less the more heat they contain. With respect to gaseous matters, it was generally thought that, under the same pressure equal increments of heat were attended with equal augmentations of bulk; but recent investigations have shown, that Marriotte's law, as the expression of this supposed fact was termed, is only approximately true. When any body changes from a solid to a liquid form, or from a liquid to a gaseous form, a quantity of caloric combines with it, of which the thermometer gives no indication. This is termed combined or latent heat. For instance, when a pound of ice, at 32°, is mixed with a pound of water, at 167°, the ice melts, and yet the two pounds of water are found to have no higher temperature than 32°. Hence, it seems that the pound of water is deprived of 135° of heat in order to render an equal quantity of ice fluid.

A pound of steam of the temperature of 212° will raise the temperature of 109 lbs. of water 11°; whilst a pound of boiling water, having a temperature of 212°, will raise no more than about 13·12 lbs. of water 11°. Steam, consequently, possesses a great quantity of latent heat.

Evaporation is the giving off of vapour from the surfaces of liquids at temperatures below the boiling point. It always produces cold; and the evaporation of some liquids can be made so rapid, as to produce a degree of cold sufficient to freeze water.

The *ebullition* of a liquid commences when the pressure of the vapour, which the heat occasions, is greater than the pressure of the atmosphere. Consequently, boiling takes place at a low temperature when the liquid is under an exhausted receiver. Water boils at a lower temperature on a mountain than on a plain, because the atmospheric pressure is less. Attempts have been made to take advantage of this fact in measuring the heights of mountains. For each inch of barometrical depression there is a difference of about 1·459°. Liquids which hold salts in solution require a higher temperature than ordinary to make them boil. Thus, the boiling heat of water saturated with nitrate of ammonia is 388°.

The following table gives the degrees at which several substances reach their melting and boiling points:—

	Melting Point.	Boiling Point.
Carbonic Acid,	— 85	
Ether,	— 47·2	
Mercury,	— 40·9	666·8
Sulphuric Acid,	— 13	550·4
Bromine,	— 4	116·6
Hydrocyanic Acid,	5	79·7
Water,	32	212
Phosphorus,	113	482
Potassium,	136·4	
Wax,	152·6	
Sodium,	194	
Iodine,	224·6	356
Sulphur,	228·2	559·4
Camphor,	347	539·2

Propagation of Heat.—Whatever may be the nature and cause of caloric, this agent manifests its influence not only by direct contact, when it is said to be *conducted*, but also in straight lines through free space, as well in a vacuum as through certain media. This property is termed the *radiation* of heat, and it belongs to all bodies which are of higher temperature than those surrounding it. Some philosophers, indeed, assert, that constantly, from all points of space, whatever may be their temperature, calorific rays are emitted in quantity proportional to that temperature. The thermometric condition of a body undoubtedly depends upon that of all the bodies, to the influence of whose radiating powers it is subjected. The propagation of heat, whether by conduction or radiation, seems to be a consequence of that property of caloric, by which it is diffused in its endeavours to find an equilibrium. When bodies of different temperatures are placed near one another, the warm ones lose, and the cold ones gain heat, until their temperatures are equal. Bodies are said to cool when they thus give off a portion of their heat to a neighbouring medium, or a neighbouring body. The conduction of heat, according to Fourier, consists in radiation from one atom to another.

The intensity of the heat radiating from a hot body is in an inverse ratio to the square of the distance. When radiating from a surface, its intensity varies with the sine of the angle which the radiation forms with that surface. The maximum emission takes place when the heat radiates in a line perpendicular to the surface; and the minimum, when it radiates in a direction parallel to the surface. The nature of the surface of a body has considerable influence upon the radiation and absorption of caloric. Thus it was found that a cubical tin vessel, containing warm water, and coated with lamp-black, had a radiating power of 100; coated with isinglass, 75; with tarnished lead, 45; with polished iron, 15; with tin-plate, gold, silver, or copper, 12; and similar results were obtained when the ratios of cooling of liquids in vessels of the same shape and capacity, but with different surfaces, were noticed. Hence, vessels which are wished to retain their heat, such as tea-pots, should have a bright exterior. Pipes which convey warmth, by means of hot water, into rooms, should be kept bright in their course, but in the room itself they must be dulled.

Heat can be reflected, and the angle of reflection is equal to the angle of incidence. It can be concentrated in the focus of a concave mirror. The rays of heat suffer refraction in passing from one medium into another. In these properties heat resembles light. That portion of the incident heat which is not reflected or transmitted, is absorbed by the body whereon it falls. Bodies with rough surfaces absorb, those with polished faces reflect, the majority of the hot rays. Every source of heat emits calorific rays, possessing various degrees of refrangibility; the hotter the source, the greater is the number of the more refrangible rays which it sends forth. Bodies at which calorific rays arrive, have different degrees of aptitude for absorbing them, varying with their refrangibility. Thus, snow absorbs chiefly the less refrangible, and reflects the more refrangible rays.

Those substances which refuse to transmit radiant heat, as opaque bodies refuse to transmit light, are styled *athermanous;* and those which possess the opposite property, *diathermanous.* Glass, natural crystals, and liquids, belong to the former; metals, wood, and stone, to the latter. Diathermaneity is independent of transparency; athermaneity of opacity. The power of transmitting radiant heat is possessed, in very different degrees, by bodies of the same transparency. Thus, thin plates of glass and rock crystal were found to transmit 62 out of 100 incident rays; whilst plates of mineral salt and alum, of the same thickness, and apparently the same transparency respectively, transmitted 92 and 12 rays out of 100. On the other hand, the transparency and thickness of the medium exercise some influence on the rays transmitted; but that influence is relative, and always subordinate to the nature of the diathermanous substance. Thus, of two plates of glass forming part of the same sheet, one was roughened on the surfaces, and it was found that only 16 out of 100 rays were transmitted, whilst the other transmitted 56. The thicker the medium, the fewer the rays transmitted; but the law governing the proportions has not yet been discovered. For instance, if 1000 rays of heat are made to fall on 4 plates of glass, having a relative thickness of 1, 2, 3, 4, and the first transmits 619, the second will be found to transmit 576, the third 558, and the fourth 549; and the same results will be obtained, if, instead of employing single plates of these proportionate thicknesses, we make up the different thicknesses by several plates. The term *diathermanism* has been invented to express the superior aptitude for transmission which some rays are supposed to possess over others. A ray is said to be thermanised, when, having passed through a given substance, it is rendered more fit to pass through another thickness of the same substance, being then much less liable to absorption than before. The number of rays transmitted by a diathermanous body does not depend upon the temperature of the radiating source, but depends entirely upon the constitution of the diathermanous medium, each body being penetrated by certain calorific rays more readily than by others, whether these rays are emitted at a higher or lower temperature. All experiment seems to prove that there is no such thing as warm light, or luminous heat. A combination of thermanising substances, green glass and alum for instance, will absorb nearly all the incident heat without injury to the light; and a combination of plates of black glass, or smoked rock crystal, will transmit heat, whilst hardly a ray of light passes through.

Some bodies possess the property of absorbing heat, and spreading it through their mass, much more quickly than others; and hence, we speak of good conductors and bad conductors. Metallic bodies belong to the former class, porous bodies to the latter. The following numbers express this power in the bodies to which they are affixed:—

Gold,	1000
Platina,	981
Silver,	973
Copper,	898
Iron,	374
Tin,	303
Lead,	180
Water,	9

Atmospheric air, as well as all the gases, are bad conductors of heat; and so are all minutely-divided bodies, even metallic filings. It is with the view of preventing the escape of heat from our bodies into the atmosphere in cold weather, that we put on additional clothing of a bad conducting quality, such as woollen. All bodies are not expanded in an equal degree by the application of a like quantity of heat. Different substances, at the same temperature, do not contain the same quantity of caloric. In other words, they have different capacities for heat; and the quantity of heat which a given weight of matter requires for the elevation of its temperature from one point to another is termed its *specific heat.* We take, as unity, the quantity of heat necessary to raise a quantity of water, of the same weight as the substance we wish to experiment upon, through the same range of temperature. The capacity for heat of any given body increases with its temperature. It is supposed that the specific heats of elementary bodies vary inversely as their atomic weights, and their latent heat vary in the same ratio.

Having now given an outline of the laws of heat, as that agent operates upon the particles of matter, its operation upon the mass of the atmosphere and the earth remains to be considered.

Temperature of the Atmosphere.—The sun is the principal agent which modifies the temperature of the atmosphere. The proper heat of the earth exerts so feeble an influence that we may leave it out of our calculations. The temperature of the air is ascertained by means of a thermometer hung in the shade, and protected as far as possible from the effects of conduction and radiation. If no means are taken to obviate accessions of heat from these causes, the thermometer will only indicate the temperature approximatively. The radiation of heat from the ground, from the clouds, and from adjacent bodies, will modify the indications of the instrument. Since the temperature is continually changing throughout the day, it is desirable to obtain the mean diurnal temperature, and that is done by dividing the sum of the degrees by the number of observations made during twenty-four hours. Of course the more observations that are made at regular intervals, the greater the accuracy of the result.

Diurnal range.—The minimum of the diurnal variation takes place about half an hour before sunrise. The maximum in these climates is about two in the afternoon; in summer a little earlier, in winter a little later. When the sun is above the horizon it warms the earth and that part of the atmosphere which is in contact with it. Part of the heat penetrates into the ground, the rest radiates into the celestial spaces. At each instant of the sun's passage to the meridian, the earth receives a quantity of heat greater than that which it loses by radiation, and its temperature augments even after the sun has passed the meridian. But when that body approaches the horizon, the quantity of heat lost by radiation is greater than what it receives, and the earth cools. As soon as the sun has set, the earth ceases to receive heat from that source, but its radiation into space continues, and the temperature falls until the sun again brings warmth and light.

In order to ascertain the mean daily range, it was at first deemed necessary to take observations every hour. Afterwards it was found sufficient to note the temperature at 4 a.m. and 4 p.m.; at 10 a.m. and 10 p.m.; or at the hours of 6 a.m., 2 p.m., and 10 p.m.

The register thermometer promised to furnish a still more simple means of ascertaining the mean temperature, and if the instrument could be kept in good working order it would be very valuable, since, by giving us each day the maximum or minimum, it would be sufficient to take the difference of these two quantities to multiply that difference by a coefficient which varies each month of the year, as shown in the following table, and to add the product to the minimum temperature.

Table for calculating the mean temperature of the day from the indications of the Register Thermometer.

Month.	Factor constant.
January,	0.507
February,	0.476
March,	0.475

Month.	Factor constant.
April,	0.466
May,	0.459
June,	0.453
July,	0.462
August,	0.451
September,	0.433
October,	0.447
November,	0.496
December,	0.521

Suppose that we wish to know the mean temperature of some day in the month of August. The thermometer gives a maximum of 80°, and a minimum of 50°; their difference is 30°. Now 30° × 0.451 = 13°.530. Hence the mean temperature will be 13.530 + 50° = 63°.530.

The mean monthly temperature is obtained by dividing the daily means by the number of days in the month.

Annual range of the Temperature.—In comparing the monthly means of the same month of different years, we perceive that they differ sensibly. But the mean of the year obtained at any given place by dividing the sum of the monthly means by 12, differs very little. Out of the tropics, the annual range of the temperature is the following:—From the middle of January it increases at first slowly; rapidly in April and May, and attains its maximum towards the end of July—then it decreases at first very slowly, then more quickly in September and October, and it attains its minimum towards the middle of January. This regular movement is a consequence of the length of the days, of the height of the sun above the horizon, and of the changes, more or less rapid, of his declination. As long as the earth obtains more heat during the day than it loses in the night, the temperature increases; the maximum takes place after the summer solstice, when the loss and the gain balance each other.

The meteorological division of the season differs from the astronomical division. *Winter*, December, January, February. *Spring*, March, April, May. *Summer*, June, July, August. *Autumn*, September, October, November.

Recent observations, made with great care at every hour of the day, give the following singular results:—

There are two periods of the day, the mean temperature of each of which, respectively, represents the mean temperature of the whole year, and these periods are separated from each other by an interval (termed the critical interval), which is nearly of the same length year after year. At Padua, the mean critical interval is 11 hours 14 minutes; at Inverness, 11 hours 13 minutes; at Plymouth, 11 hours; at Philadelphia, 11 hours 20 minutes; at Colombo, 10 hours 55 minutes; at Madras, 10 hours.

The half sum of the mean temperatures of any two hours of the same name (termed homonymous hours), has an average difference of only a quarter of a degree of Fahrenheit from the mean temperature of the year. The homonymous hours are very unequally distant from the hour of the maximum of the daily temperature, and the hours of equal temperature give for each place an epoch very different from that of the maximum. It is a thing truly remarkable, that from the mean of two epochs we may deduce the mean temperature of the whole year; that is to say, the mean of all the horary ordinates.

The relation which the mean temperature of each hour of the day bears to the whole year being discovered, the mean temperature of the year may be deduced from registers which contain only a single daily observation.

"If (says Sir D. Brewster in the North Brit. Rev. vol. v. p. 455) we measure and represent by lines the temperature of every hour of the year, we cannot recognise, in our climate at least, any trace of a law which regulates the daily progression of heat. For weeks and months, the hourly variations are of the most capricious and irregular character—the thermometer being sometimes stationary for a day, sometimes highest at midnight and lowest at noon. When we combine, however, the 365 observations of each hour by taking their mean, we find that these hourly means are the ordinates of a curve of beautiful regularity, each of the four branches of which do not differ more than a quarter of a degree of Fahrenheit from parabolas! The varying temperature of the day, therefore, with all its starts and irregularities, is controlled by a law as precise and unerring as that which regulates the planetary motions."

STEHLIN'S OSCILLATING PILLARS FOR SUSPENSION BRIDGES.

In the general construction of suspension bridges, it appears to have escaped the attention of engineers, that by carrying the frictional movement of the suspension chains to the tops of the towers or pillars, the evil effect of such movement is aggravated in the ratio of the extent of the tower's leverage, or distance from its base. The mere tensional strain of the weight of the bridge thus becomes a most powerful agent in destroying the stability of the towers; and, when assisted by the shocks and undulatory movements resulting from the passage of heavy bodies, or, still more, from the action of the wind, the lateral top pressure becomes a source of danger by no means insignificant.

Mr. K. Stehlin, a young Swiss engineer, has lately drawn our attention to this constructive defect, and has favoured us with a sketch of a plan which he proposes for the removal of the difficulty. Our annexed engravings will explain the contemplated arrangement, which presents a simple and peculiarly ingenious means of improvement of at least certain classes of suspension bridges. Figure 1 is an end elevation of a cast-iron pillar, as erected for carrying the suspension chains, and fig. 2 is a corresponding side view. The pillar is composed of two side standards, furnished with eyes at their lower ends, by means of which they are keyed, or otherwise fixed, upon a single horizontal shaft at A A, carried by two inside and two outside bearings, in which it may oscillate to accommodate the pillar to the strains of the bridge. These two standards are connected transversely by a cast-iron cross-beam, B, which binds the whole together, at the same time forming an entrance arch for the roadway. The suspending chains are simply jointed to bolts at C C, carried by the tops of the standards. Thus, in place of the pillars having to sustain the entire strain of the bridge at their upper ends, these portions serve merely as conductors to the base, where no harm can be done, and the entire pressure is constrained to act in the direction of their length.

Fig. 1.

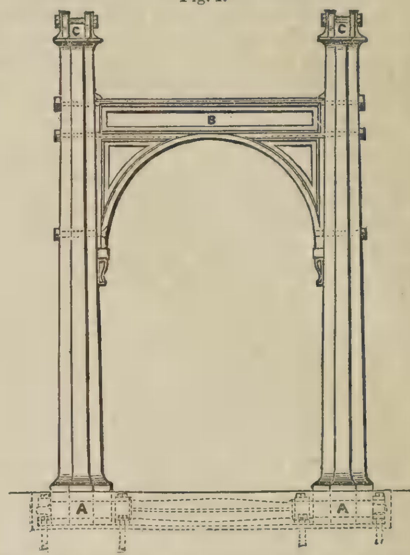
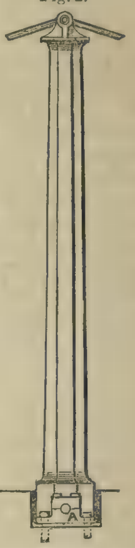


Fig. 2.



As bound together in the way Mr. Stehlin has shown, the different parts of the pillar form one stiff frame, working freely at the bottom in accordance with the strains, and strong enough to resist any transverse pressure arising from a strong wind blowing up or down the river.

STEAM AND HYDROSTATIC CRANES AT GLASGOW HARBOUR.

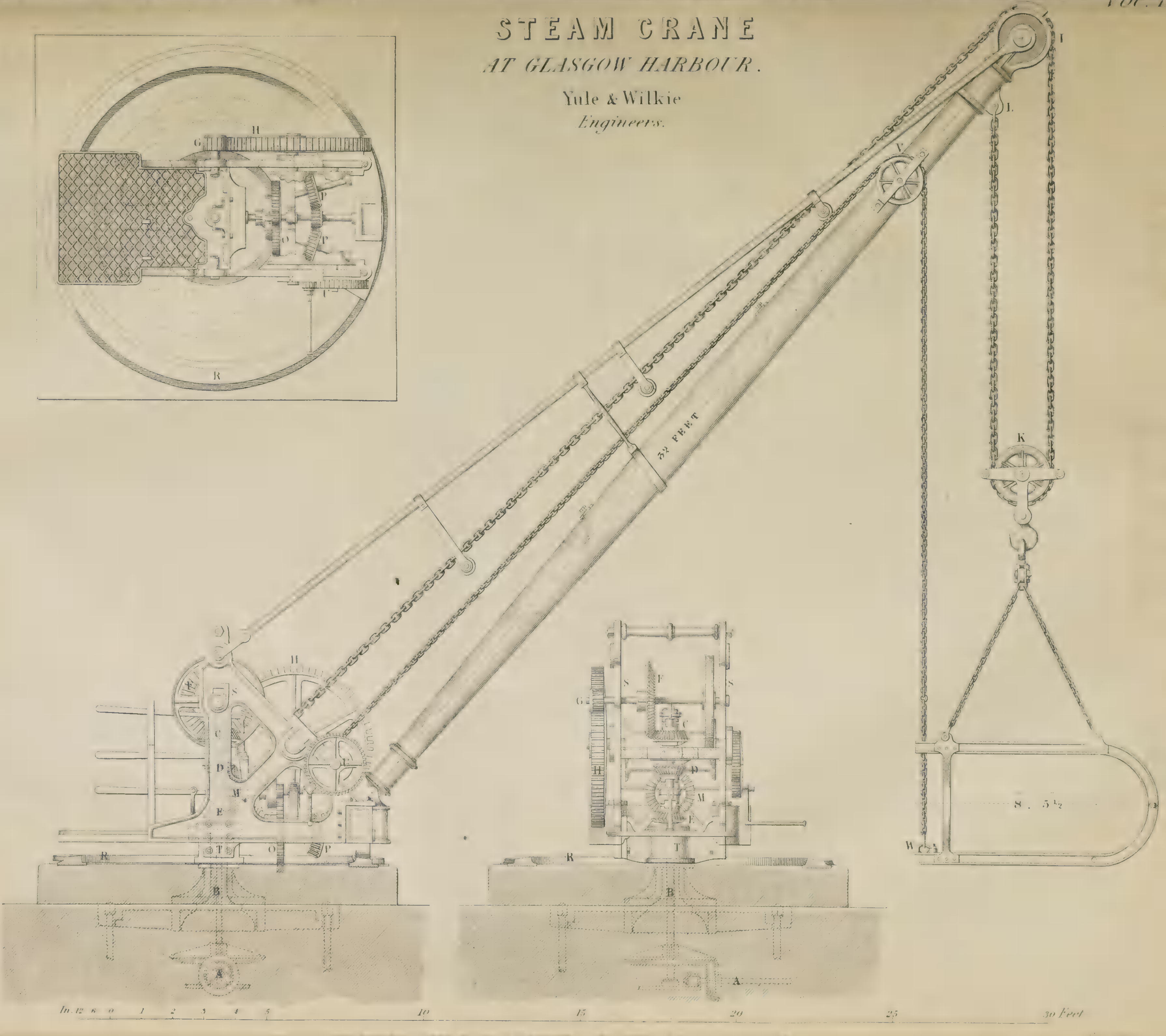
(*Illustrated by Plates* 33 *and* 34.)

The application of mechanical power for the raising and lowering of great weights, through the medium of cranes or hoists, is an important step in that refinement which leads us everywhere to substitute inanimate for animate labour. It is to this that all our advances tend; for, throughout all our progressive improvements and re-arrangements of mechanical movements, the demand for mere labouring force is more closely restricted to them, and the human labourer is more at leisure to cultivate the intelligence and skill necessary to enable him to direct and control his assistant mechanism.

The large cranes lately erected at the harbours of Troon and Glasgow are the most complete examples of the successful employment of steam power for shipping heavy weights. In plate 33, we have given a side elevation and a plan and end view of the gearing of the crane erected at the latter harbour, by Messrs. Yule and Wilkie, of this city. It is a 10-ton crane, and occupies the position at the Springfield Quay, pointed out in our plan of the harbour, plate 29, where two steam and two hydrostatic cranes are marked as intended to be erected. They are there mentioned as being 8-ton cranes; but we have since learned

STEAM CRANE
AT GLASGOW HARBOUR.

Yule & Wilkie
Engineers.



that both classes have been constructed to carry 10, and have been tested with 11 tons. In its general arrangements, it is the same as the one erected at Troon by the same engineering firm.

The engine, which is a small horizontal one, is placed beneath the level of the quay, by the side of the crane centre, and its crank-shaft carries the bevel-wheel, A, which is in reality the same size as the larger one on the vertical centre shaft, B, gearing with it. This shaft carries three loose bevel-pinions, C, D, and E, which may be connected at pleasure by clutches, so as to revolve with the shaft. In the drawing they are all out of gear; but if the top clutch is lowered by the uppermost lever-handle seen in the side-elevation, the pinion, C, will be in gear, driving the bevel-wheel, F, keyed on a horizontal shaft, having a pinion, G, on one end, working into a large spur-wheel, H, on the shaft of the chain or winding barrel. From this barrel, the chain, of $\frac{7}{8}$ inch iron, passes over a series of three guide rollers, carried by hangers from the back tension-rod, which connects the end of the jib with the top of the frame of the gearing, thence over the pulley, I, in the end of the jib, and round the moveable pulley, K, being finally linked to an eye at L, on the jib. The revolving movement of the crane, in both directions, is accomplished by the bevel-wheel, M, which may be thrown into gear with either of the two pinions, D and E, by means of the double clutch in connection with the lowest of the three lever-handles. The opposite end of the shaft of the wheel, M, carries a small spur pinion, gearing with a spur-wheel on a short shaft beneath, in the centre of which is a bevel-pinion gearing with two bevel-wheels, P, P, one on each side of the shaft. The shafts of these wheels radiate outwards from the main centre of the crane, and carry, at their outer ends, broad flanged pulleys, fitted to run on the circular cast-iron rail-track, R; and, by this means, as one or other of the two pinions, D and E, is put into gear, the tractive power of the two pulleys, upon which the whole strain of the jib is brought, carries round the crane accordingly. The whole of the gearing is carried by the two cast-iron side-frames, or cheeks, S, which have projections at their lower ends, by which they are bolted to the strong cross-head, T, acting as the main centre for the revolution of the whole. The peculiar purpose for which it is intended to employ these cranes, is the shipping of coals brought by the railways in connection with the harbour, as explained in our large plate, 29. For this end, a large wrought-iron cradle is slung to the hook of the main chain, by a cross-head, carrying two $\frac{5}{8}$ inch chains at each end, linked to the top bar of the cradle, and to one end of the latter a tipping chain is attached, for elevating one end of the waggon in the act of discharging its load of coals. A $\frac{5}{8}$ inch chain is employed for this purpose, being attached at one end to the barrel of a shaft carrying a a spur-wheel, U, into which a small pinion, on the shaft of a winch-handle, gears—this arrangement being necessary for adjusting the length of the chain, so as to tip the waggon at the proper height. The chain passes from its barrel, over the pulley, V, on the side of the jib, and thence, descending, it is connected, by two short lengths of chain, to links on a cross-bar, W, at the open end of the cradle. In lowering a waggon, the tipping chain is taken up or let out by the winch, until its length is such, that when the cradle is lowered, it will act as a stop for one end of the latter at the right time for the delivery of the coals into the hold. The end in question being held, the opposite one descends, until the angle is sufficiently great to cause the coals to fall through the end of the waggon, which is previously unfastened. The cast-iron platform attached to the back of the framing, and revolving with it, is the station of the attendant, who can, from his post here, attend to the different clutches for the several movements of the crane, as well as to the break, the friction-band of which is worked by the central lever in the side view.

In plate 34 we have illustrated the ingenious hydrostatic crane, invented by W. G. Armstrong, Esq., and constructed by him at the Elswick Engine Works, Newcastle. Our drawing is a faithful copy of the one erected at the harbour here, to work side by side with Messrs. Yule & Wilkie's steam crane, and is constructed to carry the same weight. The actuating mechanism is placed in a long narrow cavity, formed in the masonry of the pier, and at one end of this, the pressure cylinder, A, bolted by flanges at each end to the masonry, its seat being slightly inclined in order to carry the connections sufficiently low to clear the main centre. The piston-rod of this cylinder carries a large chain pulley, B, on its extremity, the carriage of which has a small supporting anti-friction roller, running upon a rail, C, carried by a series of short standards at the bottom of the chamber. The end of the main chain is attached to a fixed eye at D, and thence passes round the travelling pulley, B, to the fixed pulley, E, of the same size, beneath which it turns, passing up the centre of the hollow cast-iron pillar, which forms the fixed centre of the whole, to a third pulley, F, at the top, thence over the pulley, G, at the end of the jib, to the cross-head, H, from which the cradle is suspended. Two strong cast-iron levers, I, are attached, one on each side of the main pillar, being bolted to a revolving collar at the top, and again attached, by their lower ends, K, to a heavy collar beneath the top plate which covers in the machinery. On the bottom edge of this collar is formed a spur-wheel, L, into which the teeth of the long horizontal rack, M, gear. This rack is attached to the end of the piston-rod of a second and smaller pressure cylinder, N, employed for swinging round the jib, which revolves, by means of its two collars, upon the fixed main pillar, stepped into the stationary frame, O, bolted down by means of radial eyes to the masonry beneath. The water, which, in the case before us, is supplied under a pressure of about 210 feet, is conveyed to the cylinder, A, by the port, P, its action pressing the piston towards the bottom of the cylinder, and this movement is doubled on the chain, by the pulley arrangement before explained.

The tipping arrangement employed here is the same as that described in the steam-crane. It is adjustable by a winch-handle, the pinion on the shaft of which works into a spur wheel, Q, on the chain barrel placed on the upper side of the two timbers forming the jib. The chain passes round a guide roller beneath, and thence to a swing pulley, R, in the centre line of the pulley on the extremity of the jib, descending to the cross-bar, S, of the cradle, an end view of which is here given. The water way for the small swinging cylinder, N, is at T.

The gearing for handling the crane is on the landward side of the main pillar. The valve handles pass through the top of a handsome chest, so that the attendant is able at once to obtain any required movement. The great difficulty with which the inventor has had to grapple, in reducing so unmanageable an agent as water, under heavy pressure, to working limits, was the shock arising from opening or closing the different valves. By an ingenious adaptation of relief valves, the objectionable shocks have been completely removed, so that, whenever the sudden closing up of the water way to the cylinders takes place, the additional pressure upon the machinery is got rid of by the relief which the opening of a separate valve affords.

The crane, as a whole, presents a very handsome appearance, and is managed in the easiest manner. The great power obtainable from machines of this class, is most important, as connected with the extensive traffic which the carrying out of the general railway terminus scheme at the harbour must necessarily involve. These works are rapidly approaching completion, under the efficient management of Mr. Neil Robson, to whom we have been indebted for many of the details now furnished.

SIMPSON AND SHIPTON'S HYDROSTATIC GOVERNOR.

(*Illustrated by Plate* 34.)

Watt's original conical pendulum governor has been threatened by many rivals; but, despite its alleged inaccuracies, it still maintains its position as the simplest and most easily managed regulator of mechanical power.

In figs. 2 and 3 of plate 34, we have given an external elevation and a vertical section of a new candidate for favour, by Messrs. Simpson and Shipton, of Corporation Street, Manchester. It is of very elegant construction, the body or main feature being a cast-iron vase, A, partially filled with water, oil, or other fluid, and having a spindle, B, passing vertically up its centre from below. This spindle is ingeniously passed through the bottom of the vase, without the use of a stuffing-box, by screwing into the hollow stem of the vase a wrought-iron tube, standing up in the interior sufficiently high to project above the level of the fluid in the vase. The spindle works against a brass centre point at its upper end, carried by an arched bracket surmounting the vase; and it is supported at the bottom by a footstep in a cross-piece cast on the base frame upon which the vase rests, and derives its motion from a pair of bevel wheels, as in an ordinary governor. Upon the upper part of the spindle is a fast key or feather, upon which the upper end of a long brass boss, C, is fitted to slide. Immediately above the top of the tube through which the spindle, B, works, the boss, C, expands, so as to surround and clear the tube in its extension down to the bottom of the vase. Upon this expanded portion is formed a wide screw-thread, D, like that of the early marine propellers; and it is the revolution of this, in the liquid contained in the vase, which furnishes the means of regulation of the movements of the engine to which the arrangement is applied. The upper extremity of the screw-boss has a fast collar, E, formed upon it, for the reception of a loose boss or ring fitted with two stud pins, to which are jointed two short links attached to one end of a lever, F, whose opposite end communicates with the throttle-valve. As a reactive power against the upward pressure of the screw-blade, an adjustable spiral spring, G, is passed over the upper end of the spindle, abutting against a fast collar at the top of the spindle, and, at its opposite end, against the washer placed on the top of the collar, E.

As the screw-spindle revolves, the screw-blade or propeller is constantly acting with a downward pressure upon the fluid contained in the vase, and the reaction thus occasioned tends to elevate the screw, forcing its boss against the spiral spring, G, until it finds a neutral point, where the upward reactive force of the screw, and the downward reaction of the spiral spring, are mutually negatived, the one by the other—the position of this neutral point, of course, depending entirely upon the velocity with which the screw revolves. Upon the occurrence of the least change in the speed of the engine, whether quicker or slower, an upward or downward motion will be given to the end of the lever, F, and from it to the throttle-valve.

Of the previously invented substitutes for the conical pendulum, Messrs. Simpson and Shipton's contrivance bears the strongest resemblance to Mr. Hick's atmospheric governor, where the atmosphere stands in the position of the oil in the vase, its reaction against a pair of horizontal revolving wings or vanes producing the regulating movement through the intervention of a screw-threaded spindle.

The hydrostatic governor presents a very elegant appearance. It is of cheap construction, appears to possess a delicacy and certainty of action, and, we should say, is not likely to become deranged in working.

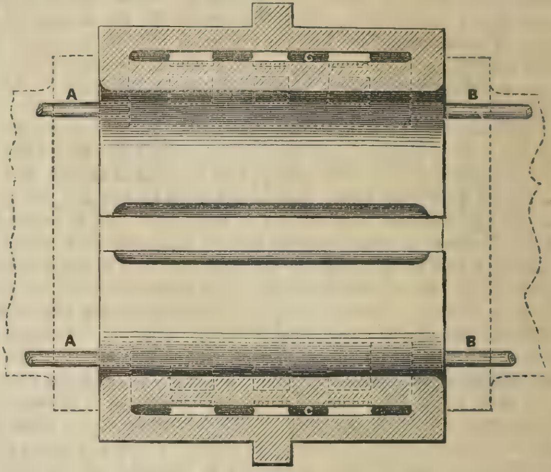
HOLLIDAY'S SELF-GENERATING GAS LAMP.

This clever invention—figured and described by us at page 180, vol. i.—has just passed through the Court of Queen's Bench, in an action for infringement of patent right, brought by the proprietors, Messrs. Holliday, of the Turnbridge Works, Huddersfield, against a party of the name of Fawcett, of the same town. From the evidence adduced upon the occasion, it appeared, that though several patents had been taken out for portable lamps, to burn gaseous or spirituous liquids without the use of wicks, none of them had succeeded in that object, so as to bring them into extensive use, until the improvements introduced by the plaintiff had removed the former defects; and that since those improvements had been effected, the sale had been very great; and the utility of the new lamp was so manifest that many parties had commenced to make them without due license from the patentee, and, amongst the foremost, the defendant, whose son had been in plaintiff's employ during the time that the models of the different kinds of burners patented had been made, for the purpose of being set forth in the specification. In support of the plaintiff's case it was proved, that, until plaintiff's lamp was introduced, none of them had been successful to any extent, the peculiar forms of the plaintiff's burners being quite new. Evidence of the extensive sale of the plaintiff's lamp was also given, and the lamp itself exhibited in court in full action, producing a very splendid flame, resembling that of a gas flame or burner. It was also shown that the defendant had, in the opinion of the witnesses examined, infringed upon plaintiff's patent; and in support of their testimony, sections of each burner were produced. Counsel, in setting forth plaintiff's case, stated that the action was brought to assert the right of plaintiff, and not with the view of obtaining damages. The defence was, that the patented improvements were not new; and in support of this plea, evidence was adduced to show that a burner for a vapour lamp, similar to that claimed by plaintiff, had been sold and invoiced to a party in the month of November, 1847, being nearly two months prior to the sealing of the patent. On examination, however, in court, the burner proved to be essentially different. Other witnesses were also called to state that they had made burners for vapour lamps, varying slightly from plaintiff's, before the patent, but did not produce any. An attempt was also made by defendant to show that he was not the party that sold the particular lamp upon which the action was brought, but that the lamp business was his son's, though conducted in his (defendant's) shop. This portion of the defence, however, signally failed; for it was proved that the defendant was present when the lamp was sold, and the invoice was made out in his name, and receipted by defendant also. The case having been gone through, the judge, after commenting on the evidence, told the jury that if they thought the invention of plaintiff superior to others, it was sufficient to establish his exclusive right to make and vend the same, and he accordingly left it to the jury to say, first, whether the defendant sold the lamp upon which the action had been brought, and, second, whether the invention was new. The jury retired; and on returning into court, gave a verdict for the plaintiff, on both the points left to them by the judge. The judge's associate, on receiving the verdict, stated to the jury, that, having found in favour of the plaintiff's *right*, it would only be necessary to specify a nominal sum, as the plaintiff had not made it a question of damages. The jury, therefore, found damages one farthing. The judge, upon being applied to, certified for costs, which the defendant will accordingly have to pay on both sides.

As this is a very meritorious and useful invention, we have pleasure in recording the successful issue of the suit.

BRUNET'S REFRIGERATING BRASSES.

This is a modification of the ordinary journal brass, the intention of which is to prevent the heating and wear so often complained of in brasses of the usual kind. The inventor, Mr. J. J. Brunet of the Canal Iron Works, Limehouse, London, has furnished us with explanatory drawings of his contrivance, from which we have made the annexed wood engraving, representing a pair of the brasses in longitudinal section. The plan consists in forming a cavity in the shell of each brass, through which, a stream of cold water is constantly passed. The water enters by the tubes, A, A, and after passing along the cavity, C, it is discharged at B, B. To give strength to the shell, the cavity is supported at intervals by pillars of metal. In cases where the joints or journals move round an external axis, as in connecting-rods, flexible pipes are employed to conduct the water, as in the hollow crank pins of the engines of the Great Britain.



In spite of our presumed perfection of machinery, we are not yet in possession of any certain means for preventing the heating of brasses. So much is this the case, that we not unfrequently see a stream of cold water applied externally to journal bearings to carry off the great heat. By the introduction of Mr. Brunet's system, the engine-man can at any time surround the journal with a continuous stream of cold water, without running the risk of deluging the rest of the machinery by an external application.

LOCOMOTIVE ENGINE-SHED AT BURNTISLAND.

The locomotive engine-shed, on the Edinburgh and Northern Railway at Burntisland, possesses some features of peculiarity in its roof, which are worth recording. Although the building is 141 feet in diameter inside, the roof is entirely supported by the walls, without any auxiliary columns. The centre is occupied by a 34-feet turn-table, from which radiate sixteen stands for engines. The wall is 22 feet high, and 3 feet thick. On the top is a stout iron wall-plate, in which one end of the iron couples is secured. In ordinary roofs, the tie-bar of a couple may be said to support the weight *indirectly*, but in the present instance the weight rests upon it *directly*, and the sloped sides project into the interior. The couples are of iron bars, 6 inches broad, and 1 inch thick—two of these bars are used—set two inches apart; they are 78 feet in length. One end is set in the wall-plate, and the other is made fast to an iron ring at the top of the roof, 15 feet in diameter, from which rises a dome 13 feet high.

There are fifty-two couples; the sloping sides of them are formed of 2-inch round iron. The king-post is 6 feet long, with two smaller ones on each side of it, the distance between each being 13 feet. Through the head of each of these posts is passed a 1½-inch round bar, which goes right round the roof, thus binding it all together. The perpendicular height from the floor to the base of the dome is 64 feet.

Round the base of the dome is a circle of plate-glass, composed of plates 5 feet long; and half-way between that and the wall is another circle of panes of the same dimensions. It has, in addition, twenty-eight arched windows, 10 feet by 4 feet. The weight of the roof, including iron-work, slates, and glass, is stated to exceed 200 tons.

A handsome porch is formed by a square building, through which the engines pass and repass; and this carries an iron tank, capable of holding 70,000 gallons of water. The lower front of the porch is occupied as superintendent's offices. It was executed by Messrs. Robertson and Lister of Glasgow.

STATISTICS OF LOWELL MANUFACTURES, 1849.

The accompanying Statistical Table of Manufactures, in the celebrated American manufacturing district of Lowell, will be found interesting, as explanatory of what our neighbours are doing. It was supplied to us by Messrs. J. B. Francis and W. A. Burke; the former of whom has the management of the water-works, and the latter that of the machine shop at Lowell:—

CORPORATIONS,	Merrimack Manufac'ing Co.	Hamilton Manufac'ing Co.	Appleton Co.	Lowell Manufac'ing Co.	Middlesex Co.	Suffolk Manufac'ing Co.	Tremont Mills.	Lawrence Manufac'ing Co.	Lowell Bleachery.	Boott Cotton Mills.	Massachusetts Cotton Mills.	Lowell Machine Shop.	Total.
Incorporated,	1822	1825	1828	1828	1830	1830	1830	1830	1832	1835	1839	1845	
Commenced Operations,	1823	1825	1828	1828	1830	1832	1832	1833 & 1843	1832	1836	1840	1845	
Capital Stock,	2,000,000 dols.	1,200,000	600,000	900,000	1,000,000	600,000	600,000	1,500,000	210,000	1,200,000	1,800,000	600,000	12,110,000
Number of Mills,	6 & Print-Wks.	4 & Print-Wks.	2	1 Carpet. 1 Cotton.	4 & 3 Dyehouses	2	2	5	Bleachery and Dye-works.	5	6	2 Shops, Smithy, & Foundry.	48
Spindles,	67,965	36,094	17,920	3,400 Wool. 7,142 Cotton.	16,340	14,448	14,560	44,800		41,712	45,720		310,000
Looms,	1,920	1,086	600	220 Cotton. 51 Power Carpet.	45 Broadcloth. 375 Cassimere.	488	517	1,260		1,338	1,459		9,359
Females employed,	1,600	894	400	550	930	400	400	1,200	20	The Boott Cotton Mills have but two Mills now running, and as they are geting the machinery into a new Mill just built, the Statistics with regard to them are incomplete.	1,250		7,644
Males employed,	645	267	120	225	820	100	100	200	200		250	700	3,629
Yards, made per week,	345,000	180,000	130,000	6,500 yds. Carpet. 40 Rugs. 95,000 yds. Cotton	18,957 Cassimere. 2,334 Broadcloth.	100,000	120,000	260,000			475,000		1,704,996 Cotton. 21,291 Wool'n, 6,500 Carpets, 40 Rugs.
Cotton consumed per week, pounds,	79,000	60,000	50,000	50,000		40,000	35,000	95,000			150,000	4,500 tons wro't & cast-iron per ann.	559,000
Wool consumed per week, pounds,				13,000	33,000								46,000
Yards Dyed and Printed,	305,000	75,000 Printed. 15,000 Dyed.							2,000,000 dyed.				380,000 Printed. 2,015,000 Dyed.
Kind of Goods made,	Prints & Sheetings, No. 22 to 40.	Prints, Flannels & Sheetings, 14 to 40.	Sheetings & Shirtings, No. 14.	Carpets, Rugs, and Cotton Cloth.	Broadcloth. Cassimere. Plain and Fancy.	Drillings, 14.	Sheetings, No. 14. Shirtings, No. 14.	Printing Cloths. Sheetings & Shirtings, 14 to 30.	4,000,000 lbs. bleached per an.	Drillings, No. 14. Sheetings, Shirtings, Printing Cloths. } No. 30.	Sheetings, 13. Shirtings, 14. Drillings, 14.	Cot. & Wool'n M'y. Locomotives and Steam Engines. Machinists' Tools, & Mill-work.	
Tons Anthracite Coal per annum,	5,000	3,500	350	2,600	4,000	400	250	900	3,000	900	2,700	1,500 tons hard. 300 chal. soft.	25,100
Charcoal, bushels, per ann.	3,555	2,148	1,000	2,000	2,000	2,000	1,800	3,000		1,800	2,000	15,000	36,303
Wood per annum, cords,	200	500			1,000	50	150	120	500	70	100	100	2,790
Oil per annum, gallons,	13,000	9,000	5,400	Lard, 8,000. Sperm, 5,000.	Lard, 27,000. Sperm, 8,000.	3,600	3,693	8,217			12,000	3,000	70,510 Oil. 35,000 Lard.
Water-wheels, diameter,	30 feet	13 feet	2 Turbine, each 8 ft 4 in. diameter. 1 do., 5 ft. 8 in.	13 feet	12 & 17 feet	13 feet	13 feet	17 feet		17 ft., and 2 Centre Vent Wheels, as improved by Mr Francis, 9 ft. 4 in. diam'r	17 feet 2 Turbine.	13 feet	
Length of do. for each Mill,	24 feet	42 feet		60 feet	23, 21, & 45 feet.	62 feet	62 feet	60 & 80 feet		60 feet	60 feet	33 feet	
Starch, lbs., per annum,	100,000	130,000	75,000			100,000	65,000	140,000	260,000		220,000		1,090,000
Flour, barrels, per annum,	425	200					100				40		765
How Warmed,	Steam	Steam	Steam	Steam	Furn. & Steam	Steam	Steam	Steam	Steam	Steam	Steam	Steam	
Name of Agent,	E. Washburn	John Avery	George Motley.	Alex. Wright	O. H. Perry	John Wright	Chs. L. Tilden.	John Aiken	C. A. Babcock	Linus Child	Joseph White	Wm. A. Burke.	

Average wages of Females, clear of board, per week,	dols. 2,00
Average wages of Males, clear of board, per day,	dols. 0,80
Medium produce of a Loom, No. 14 yarn, yards per day,	45
Medium produce of a Loom, No. 30 yarn, yards per day,	33
Average per Spindle, yards per day,	1⅛

The Middlesex Company make use annually of 6,000,000 teasels, 1,716,000 lbs. fine Wool, 80,000 lbs. Glue, 60,000 dols. worth Dye Stuffs, and 17,000 dols. worth of Soap. They also own the Wamesit Carpet Mill, on the Concord river, where are consumed, annually, 93,600 lbs. coarse Wool, and 36,400 lbs. of worsted Yarn, producing 91,000 yards Ingrain Carpeting.

The Lowell Machine Shop, included among the above Mills, can furnish Machinery complete for a Mill of 6,000 Spindles, in three months, and a Mill can be built in the same time.

The several Manufacturing Companies have established an Hospital for the convenience and comfort of persons employed by them respectively when sick, which is under the superintendence of one of the best of surgeons and physicians.

There are two Institutions for Savings—The Lowell and the City. The Lowell had on deposit, in September, 1848, from 5,066 depositors, 852,280 dols. The City has been in operation only since March, 1848, and had on deposit, January 1, 1849, from 258 depositors, 27,717 dols. The operatives in the mills are the principal depositors in the above banks.

RAILROADS.—The Railroad communication which Lowell now has with all parts of the country, is as extensive and complete as from any other point in New England or elsewhere, scarcely excepting Boston. Eight trains pass daily each way over the Boston road. Three trains, each way, pass daily over the Nashua road, extending to Wilton, N.H.; also to Manchester, Concord, Meredith Bridge, Franklin, Bristol, Lebanon, Hanover, and Haverhill, N.H., and Wells River, Vt.; also extending from Lebanon over the Vermont Central road into the interior of Vermont; (and will in the course of the present year extend to Montpelier and Burlington on Lake Champlain.) Four trains pass daily each way over the Lawrence road to the new manufacturing town of Lawrence, from thence to Exeter, and Dover, N.H., and to Portland, Me.; also, over the Essex road to Salem. Two trains pass daily each way over the Stony Brook road to Groton, there uniting with the Townsend, Shirley, and Peterboro' road; also Fitchburg road to Fitchburg; thence on the Cheshire road to Keene, N.H., Bellows Falls and Windsor, Vt.; also uniting at Fitchburg with the Vermont and Massachusetts road; also uniting at Groton with the Nashua and Worcester road to Worcester, there connecting with the Western road for Springfield and Albany; also to Norwich and New York city by Norwich road and steamboat; also with the Providence and Worcester road to Providence.

Passengers for New York from Lowell, can have a choice of conveyances with the facilities now afforded. By leaving Lowell for Boston at 2 or 2½ P.M., they can there take either the Old Colony road at 5 P.M. to Fall River, and from thence by steamer; or the road to Providence and Stonington, and thence by steamer. Or by leaving Lowell at 4½ P.M. on the Stony Brook road, can proceed direct to Worcester and Norwich, and thence by steamer to New York.

There are three Banks:—the Lowell, capital 200,000 dol.; the Railroad, capital 600,000 dol.; the Appleton, capital 100,000 dol.

There is a valuable Library of 7000 vols. belonging to the city, to which any one can have access by paying fifty cents per annum.

Other manufactures are produced in the city than those specified above, of a value of 1,500,000 dols., employing a capital of 400,000 dols., and about 1,500 hands.

The population of Lowell in 1828 was 3,532. It is now (1849) estimated at 35,000.

The Fire Department of Lowell is very efficient and well regulated—none can be more so. The facilities afforded for extinguishing fire, by the rivers and canals running through the city, combined with the powerful action of the mills in forcing water almost wherever required, with the advantages, also, of its spacious streets, render it next to impossible for the most threatening fire to make much progress. The number of engines is 11; the number of firemen is 745; and the number of feet of hose is 17,410. The services of the firemen are paid for by the city at 20 cents per hour.

THE MECHANIC'S LIBRARY.

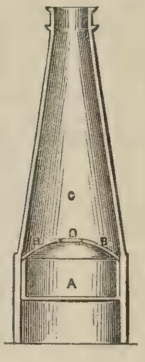
Architecture, Rudimentary, 12mo. 1s. cloth, sewed. T. T. Bury.
Britannia and Conway Bridges, Account of the, 42s. W. Fairbairn.
Copper, the Art of Etching on, 4to. 10s. 6d. vellum. A. Ashley.
Cranes and Machinery, on, 12mo. 1s. cloth, sewed. J. Glynn.
Draining, on, 12mo. 1s. sewed. G. D. Dempsey.
Etching Described, by a Practical Engraver, 12mo. 3s. 6d. cloth.
Microscope, Wonders of the, sq. reduced to 2s. cloth.
Railway Station Master's Manual, 12mo. 2s. 6d. cloth.

REGISTERED DESIGN.

MESSRS. HALFORD AND JOSEPH'S COKE OVEN.

Registered for Messrs. Halford *and* Joseph, *Tipton.*

The improvements contemplated in this oven are an acceleration of the coking action, by producing a more perfect combustion of the escape gases, and the facility afforded for the production of either a light or heavy coke. Our engraving shows the oven and chimney in vertical section. A, Is the oven, or coking chamber, having an arched top, B B, surmounted by the conical chimney, C. The passage for the flame and disengaged gases from the oven is by the central aperture, D, in its arched top. The coking action is accelerated by the combustion of the gases, as they attempt to escape by the opening, D; and by placing a damper on the top of the chimney, a coke of more or less density may be produced, accordingly as the atmospheric current has more or less play.



The novelty of the design consists in the combination of the arched top with the chimney.

RECENT PATENT.

PAPER MACHINERY.—C. R. Collins, Glasgow.

Enrolled, July 14, 1849.

This invention refers, firstly, to an improved arrangement of such apparatus, employed in the manufacture of paper, as relate to the obtainment of a partial vacuum beneath a portion of the travelling endless wire-cloth of paper machines, which receives and conveys the pulp, during the process of manufacture; and, secondly, to an improved mode of preserving an air-tight connection between the lower moving surface of the endless wire-cloth, and the fixed upper surface of the adjustable ends of the vacuum-chest or chamber, into which the superfluous water of the solidifying pulp is pressed by the external action of the atmosphere, and is thus drawn off, as also for keeping tight the edges of the adjustable ends of the vacuum-chest.

In the manufacture of paper, the requisite partial vacuum has been obtained in various ways—generally by the action of sets of exhaust-pumps; but exhausting fans and steam jets have been also applied for the same purpose. The objections against the employment of pumps are—their expensive construction, the wear and tear in working, and the impossibility of obtaining a regularity of exhaust by reason of the change of stroke of the pistons; and, although a greater steadiness may be attained by fans, or by jets of steam, yet considerable expense and trouble attends the adoption of either of these modes. Mr. Collins proposes to obviate the whole of these evils by the use of simple means, absorbing no power in working, and affording a uniform atmospheric pressure on the pulp, so that the variation which tends to produce an irregularity in the paper is entirely removed. This he accomplishes by attaching a pipe to the vacuum-chamber, of such a length, that the pressure of the column of water within it produces the amount of atmospheric pressure required. This pipe is attached to the longitudinal centre of the bottom of the vacuum-chamber, and has a stop-cock at its lower end, for the regulation of the amount of discharge of the water from the pulp. In starting the machine, it is necessary that the vacuum-chamber should be quite full of water, in order that its withdrawal through the pressure-pipe may produce a due amount of vacuum. During the action of the machine, the stop-cock is kept constantly open to the extent required; and, as the water gathers in the bottom of the chamber, it fills the pipe, and the water column thus produced, in endeavouring to fall down the pipe, produces a regular partial vacuum in the chamber sufficient to cause an external atmospheric pressure upon the surface of the pulp, to carry off the whole of the superfluous water from it. The amount of opening of the cock at the foot of the pipe is determined by the quantity of water discharged from the paper, so that whilst the flow is uninterrupted, the pressure column remains undiminished in height.

In the second portion of the invention is shown an ingenious mode of preserving an air-tight connection between the ends of the vacuum-chest and the surface of the chest itself. This is accomplished by keeping the space between the adjustable ends of the chest and the outer fixed ends of the same, full of water, so as to form a hydraulic joint, to prevent the ingress of air to the vacuum-chamber, either by the sides of the end-pieces, or over the tops beneath the wire-cloth.

The claims are—

1st. The use or employment of a pressure-pipe, or discharging channel, in connection with the vacuum-chests of paper-machines, whereby the water discharged from the pulp, in passing over the vacuum-chest, produces the partial vacuum required for the obtainment of a sufficient atmospheric pressure to separate the water from the pulp.

2d. The system or method of preventing the entrance of air to the interior of the vacuum-chest, by the use of water as herein before described.

REVIEWS OF NEW BOOKS.

An Account of the Construction of the Britannia and Conway Tubular Bridges, with a Complete History of their Progress, from the Conception of the Original Idea to the Conclusion of the Elaborate Experiments, which determined the Exact Form and Mode of Construction ultimately adopted. By William Fairbairn, C.E. M.I.C.E., &c. Pp. 291. 8vo. 21 Plates. London: Weale.

Such of our readers as are acquainted with the state of feeling which has for some time existed between Mr. Stephenson and Mr. Fairbairn on the subject of their respective claims to the merit of the construction of the Britannia and Conway tubular bridges, will have long expected the appearance of the volume now before us, in substantiation of the assertions of the latter gentleman regarding his right to a greater share of credit than has hitherto been accorded to him. Whilst we lament the occurrence of the unfortunate dispute, we are reminded that to it we are indebted for Mr. Fairbairn's splendid work, furnishing as it does, details and particulars of the bridges, which might long have remained in obscurity. Briefly to recapitulate the origin of the misunderstanding, we may state, that shortly before the termination of Mr. Fairbairn's connection with the Chester and Holyhead Railway Co., certain remarks of Mr. Stephenson's led him to foresee that the latter gentleman did not intend to offer him, by any means, a due acknowledgment for his services; and a few days afterwards, at a public dinner at Conway, he, Mr. Stephenson, claimed for himself the entire and sole merit of originating and determining upon the practicability of the tubular scheme. On the other hand, Mr. Fairbairn—allowing that Mr. Stephenson has a well-founded claim to the origination of the principle—yet stands out for the credit due to his practical working out of what, in Mr. Stephenson's hands, was nothing more than a mere idea. We have elsewhere, in the present number, referred to the initiatory steps taken by the parties concerned in the bridges; and we may quote from Mr. Fairbairn's second page some remarks on the proceedings, taken subsequent to the opposition made by the Admiralty to the erection of the proposed cast-iron bridge:—

> "It was under these circumstances—having to encounter extraordinary difficulties of execution, and being compelled, by the opposition of so powerful a branch of the government as the Admiralty Board, to abandon the ordinary resources of the engineer—that Mr. Stephenson conceived the original idea of a huge tubular bridge, to be constructed of riveted plates, and supported by chains, and of such dimensions as to allow of the passage of locomotive engines and railway trains through the interior of it.
>
> "It was with reference to this expedient, after all others had been found inapplicable, that I was consulted by him, and that my opinion was requested, first as to the practicability of the scheme, and secondly as to the means necessary for carrying it out. This consultation took place early in April, 1845, and as far as could be gathered from Mr. Stephenson at the time, his idea then was, that the tube should be either of a circular or an egg-shaped sectional form; he was strongly impressed with the primary importance of the use of chains, placing his reliance in them as the principal support of the bridge; and he never for a moment entertained the idea of making the tube self-supporting. The wrought-iron tube, according to his idea, was, indeed, entirely subservient to the chains, and intended to operate, from its rigidity and weight, as a stiffener, and to prevent, or at least to some extent counteract, the undulations due to the catenary principle of construction. In fact, for many months afterwards, and even up to the time of the experiments on the model tube in December, 1846, he insisted, as will be seen from the annexed correspondence, on the application of such chains. A perusal of this correspondence will, moreover, show that I was throughout strongly opposed to their application, even as an auxiliary. I always felt that in a combination of two bodies, the one of a perfectly rigid, and the other of a flexible nature, there was a principle of weakness; for the vibrations to which the one would be subjected, would call into operation forces whose constant action upon the rivets and fastenings of the other could not but tend to loosen them, and thus, by a slow but sure agency, to break up the bridge.
>
> "At the period of the consultation in April, 1845, there were no drawings illustrative of the original idea of the bridge, nor had any calculations been made as to the strength, form, or proportions of the tube. I was asked whether such a design was practicable, and whether I could accomplish it; and it was ultimately arranged that the subject should be investigated experimentally, to determine, not only the value of Mr. Stephenson's original conception, but that of any other tubular form of bridge which might present itself in the prosecution of my researches. The matter was placed unreservedly in my hands; the entire conduct of the investigation was entrusted to me; and, as an experimenter, I was

> to be left free to exercise my own discretion, in the investigation of whatever forms or conditions of the structure might appear to me best calculated to secure a safe passage across the Straits."

The evidence brought forward by Mr. Fairbairn in the voluminous correspondence contained in his volume, gives us a very clear idea of Mr. Stephenson's original notions of what the bridges ought to be, and the extraordinary changes which have been introduced in their actual construction—mainly owing, as we will take upon ourselves to say, to the persevering exertions of Mr. Fairbairn, aided by the researches of Mr. Hodgkinson, and the practical labours of Mr. Edwin Clarke. After going through the details of the correspondence, and the well supported supplementary statements, we are forced to the conclusion that Mr. Fairbairn's name is at least worthy of being jointly associated with that of Mr. Stephenson in the great work to which both devoted so much thought and attention. He was consulted in the earliest stage of the scheme; he contrived and carried out all the valuable experiments which led to so striking a confirmation of his views, as opposed in many respects to those of Mr. Stephenson; and, finally superintended the construction and erection of the Conway bridge. When the successful result of this erection was made quite clear, and when he foresaw that his labours were to be recognised only as an assistant under Mr. Stephenson's direction, he withdrew from the undertaking, and appealed, through the medium of this volume, to the pure facts of the case, as confirmatory of his title to be considered in a somewhat more elevated light. If anything further were wanting to show that he held a position of his own, in every way independent of Mr. Stephenson, it would be supplied by the Minute of the Board of Directors of the Railway, given at page 80, which we extract:—

> "Resolved,—That Mr. Fairbairn . . . . be appointed to superintend the construction and erection of the Conway and Britannia bridges, in conjunction with Mr. Stephenson.
>
> "2. That Mr. Fairbairn have, with Mr. Stephenson, the appointment of such persons as are necessary, subject to the powers of their dismissal by the Directors.
>
> "3. That Mr. Fairbairn furnish a list of the persons he requires, with the salaries that he proposes for all foremen or others above the class of workmen.
>
> "4. That advances of money be made on Mr. Fairbairn's requisition and certificates, which, with the accounts or vouchers, are to be furnished monthly.
>
> "5. That the Directors appoint a book-keeper at each spot, the Conway and the Menai."

It would be useless, after this, to dwell any longer on the facts laid bare in Mr. Fairbairn's book; doubtless we shall have, at an early day, further reason to consider the point of inquiry in connection with the opposite case;—until then, nothing more need be urged in support of Mr. Fairbairn's claims.

In our examination of the question, for the elucidation of which the book was written, we have here taken no note of its intrinsic merits as a contribution to the "literature of engineering." Its thoroughly practical form, the numerous experiments detailed, with the chain of reasoning which, link by link, led to the adoption of the form of tube now erected, and its valuable illustrative plates, all combine to render it one of the most valuable of the engineer's text books. As such, we shall next month devote some additional space to its consideration.

CORRESPONDENCE.

SELF-RECORDING SHIP'S LOG.

The ordinary log-ship used by sailors for rating their vessels is nothing more than a small quadrant-shaped piece of timber, loaded with lead, so as to float vertically, presenting a considerable resistance to the water when drawn against it by the motion of the ship. When hove, the log-ship remains pretty nearly in the place to which it is thrown, and thus draws the log-line from a reel on board the vessel. The log-line being divided into equal parts by knots, the time occupied in running out a series of them indicates the amount of way upon the vessel.

As an improvement upon this crude contrivance, I would propose to make the instrument act as a constant indicator of the ship's speed, by the addition to the ordinary log-ship of a spring balance, the index of which is to be graduated to miles or knots, to be measured by the pressure exerted upon the log-line, through the hold of the log-ship upon the water, when way is upon the ship. In place, then, of using a long reel of line, I would simply attach the log-ship to one end of a *stray-line*, and join the other to an indicating spring carried by the taffrail of the vessel.

It is easy to see how this arrangement would work—the faster the vessel goes, the greater is the strain upon the indicating spring, owing to the increased resistance offered by the water to the passage of the log-ship. The chief superiority of this log is, that it is constantly telling how much the ship is doing.

By a slight addition, the log may be made to indicate what the ship has done in any given time—thus, if fitted with a paper cylinder, revolving slowly by clockwork, and acted upon by a pencil carried by the index of the spring, as in a steam-engine indicator, the distance passed over by the vessel in any given period might be accurately marked out.

Bahia, April, 1849. EDMUND HUNT.

[The common log is certainly a very imperfect instrument, and all computations of a vessel's course and distance are uncertain and precarious; but we do not see that our correspondent's remarks are at all calculated to add to its efficiency as a measurer. In the first place, he leaves untouched the most objectionable feature about it—the log-ship itself, and the principle upon which it acts, in drawing out the measuring or log-line. The computations made by its means must be based upon the supposition that the log-ship remains immoveable in the place to which it is thrown; or, a mere guess amount must be added for loss by its movement in the direction of the ship's course. In either case the result is unsatisfactory. Now, by the addition of an index-spring, although the action is modified to the extent that the log-ship moves through the water, in place of drawing off the log-line from the reel, yet it is not difficult to see that the resistance with which it meets will vary according to circumstances, and that the index will show different strains upon the line, whilst no actual change occurs in the speed of the ship through the water. Stormy and calm weather, for instance, will each have their effect upon the indications; and when the ship pitches, her forward movement will give a tug to the spring far beyond the legitimate strain upon it. It is only since the introduction of Massey's patent perpetual log that the sailor may be said to have had a trustworthy measurer at his command. This log, which has now been some years before the public, has, to our thinking, approached as near perfection as the system of log-measuring permits. In this log, the distance is measured by the revolutions of a small spindle, carrying a screw-vane, like a marine propeller. This is hove overboard, and drawn at the stern of the ship, beneath the surface of the water; and, as the speed of the ship increases or diminishes, the screw, whose revolutions for a given amount of travel are known, revolves at a greater or less speed, and these revolutions are marked by a train of wheels. This log is now always used where anything like accuracy is required.—ED. P. M. JOURNAL.]

THE RESISTANCE TO RAILWAY TRAINS.

(Continued from page 199, vol. I.)

Taking public opinion as the standard of value to which all men bow, a pennyworth of practice is worth a hamperful of the soundest theory. Mr. Passavant is therefore of the right school; and having driven an engine in America, is conversant with railway practice in different sections of the globe, and may be quoted as an authority, that the pressure of the steam on the piston of the locomotive No. 60, on the trial experiment from Derby to Masborough, was probably 80 lbs., as printed in the last number of this journal.

Proceeding on this satisfactory data, we are now in a position to resume the subject of power and resistance at the point at which the calculations were suddenly stopped, for want of a test or tie in the way of double entry, and which will either prove or disprove certain calculations. The area of the two pistons is 402 square inches; their speed, when the train moves at 49 miles an hour, the driving wheels being 5·5 feet diameter, is $\left(\frac{49 \times 5{\cdot}280 \times 3\frac{1}{3}}{60 \times 5{\cdot}5 \times 3{\cdot}1416}\right) = 832$ feet per minute, nearly $3\frac{1}{3}$ feet being the length of one double stroke; and $\frac{402 \times 80 \times 832}{33{,}000} = 810$ horses, the nominal power of the engine, from which, abating one-third, there remains *only* 540 horses for its effective power.

Then, 540 horses took 98 tons at 49 miles an hour; therefore, the modulus of resistance, as derived from the power, for each ton, is $\left(\frac{402 \times 80 \times 3\frac{1}{3}}{5{\cdot}5 \times 3{\cdot}1416 \times 98}\right)$ 62 lbs.; but looking back to page 197, containing a table of resistances at different speeds, it will be seen that, at 51 miles an hour, the resistance per ton is only 26·4 lbs., being less than one-half of what has been proved on the authority of Mr. Passavant. Hence he has either committed a large mistake, which in a man of his wide practice is not to be suspected; or the alternative is, that the first talents, the accumulation of the *elite* in railway experience, who have undertaken to discover the rate of resistance, have in so far failed to accomplish their purpose, and at this day know no more of the very difficult matter with which they have been for so many years in contention, than was known twenty years ago. Thus, in my plain way of reasoning, I think the point which I have more than once before asserted, is proved.

I shall carefully avoid a wrangle with Mr. Passavant, to whom so much is due from shareholders for giving the information in the very nick of time. On the contrary, I fully agree that the atmospheric resistance cannot be removed; to undertake the job would be a real poser; but I am at default in not perceiving that it does not admit of a reduction in the proportion of five to one, we will say at a guess, and without the extra expenditure of a solitary farthing. This slight reduction (see p. 198) would knock off 416 horses from a train of 100 tons, going 60 miles an hour, the atmospheric resistance being estimated according to the experiments of the British Association. As I fail to perceive that the resistance of the air at rest, to a train through it, cannot be subdued, so I do not perceive why the resistance to a steamer would be increased if her stem and stern were flat surfaces; and I hope it will be tried, for, after all that can be said, no jokes tell like practical jokes.

I would say a word about the friction on the axle, and its reduction in the proportion of two or more to one; but much as I would advocate the division of labour when manual dexterity is required, I would oppose it in all cases wherein unison of purpose is essential; so when the carriage is made by one, the engine by another, and the result tested by an aggregation of heads, a failure may be relied on, unless a master mind designs the whole.

The market price of iron horses is very low, 540, with a tender, are laid into stock for five-and-twenty hundreds of pounds, or about £4. 12s. per head. Deduct the tender wheels, axles, boxes, springs, and buffers, and the remainder might be had for about forty-six shillings each, or £1,250, being almost the cost of a good brick chimney of a stationary engine, so that locomotives stripped of their wheels will soon be in common use, whereby the smoke nuisance will, at all events, be abated.

The water boiled away is scarcely two and a half times as much as it should be, taking the power at 540 horses; but if Mr. Passavant could be supposed in error, the water evaporated would be about five times the proper quantity, for which, although the cause is as obvious as the 80 lbs. pressure, there is no necessity; and a waste of water by evaporation is a waste of fuel, a point on which the man of theory or of straw, and the stoker of the most *intense* practice, concur.

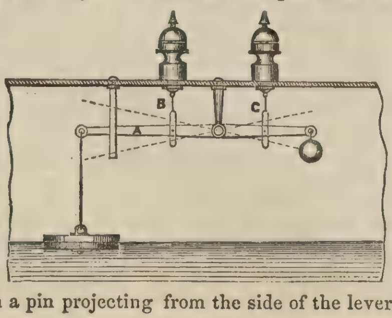
John Curr.

7 *Upper Penton Street, July* 9, 1849.

SAFETY WHISTLE FOR STEAM BOILERS.

At a time when our newspapers and journals were filling the public mind with terror, by detailing the awful effects of some recent steam boiler explosion, such a scheme as the following might have met with a more favourable reception than it may now appear to deserve. But when it is borne in mind that there are at the present time hundreds of steam boilers throughout our manufacturing districts, constantly exposed to extreme danger from being so ineffectively provided with the means of safety, there needs no apology for offering to the public any contrivance tending in the least to remedy the evil. I believe it is the general opinion—and certainly it is mine—that by far the greater number of explosions have arisen from a deficiency of water in the boiler. There are many contrivances at present in use by which this deficiency might be prevented, if properly attended to. I suppose the ordinary float and wheel is about the oldest, and perhaps the best; but it has been objected to in many instances for high-pressure boilers, owing to the great attention required to prevent the unpleasant hissing of the steam around the float-wire. In cases of very high-pressure, nothing has surpassed the ordinary guage-cocks and glass guage, such as are used in locomotives; but here they are under the ever watchful eye of an experienced driver, and seldom fail. The case is not so in numberless instances of our small manufactories, where the guage-cocks are intrusted to the care of an inexperienced lad of sixteen or eighteen; it is here we have most to fear from accidents.

The little contrivance I now beg to offer to your notice, is merely to give alarm whenever the water, through accident or inattention to the guages, should sink too low; and it might also be made to give a similar alarm when the water became too high. It consists, as represented in the accompanying sketch, of a float and lever, A, attached to the top of the boiler by the pendant, and working in a guide secured to the boiler. Directly over the lever are two small inverted valves, the seats of which pass through the boiler-plate, and are screwed into the two whistles. Each valve has a small eye, B and C, for the reception of a brass wire, bent to form a loop, in which a pin projecting from the side of the lever is at liberty to work freely up and down; each valve is also provided with a small spiral spring upon its stalk, just sufficient to keep it shut in the absence of steam-pressure. The float is here at liberty to move up and down as the water rises and falls, within certain limits, without producing any effect upon either whistle. But whenever the water descends to a certain point, which may be assigned as the extreme limit of safety, the lever-pin presses upon the end of the loop B, and opens the whistle above, upon which is engraved the word LOW, meaning "water too low;" and on the other hand, whenever the water ascends to a certain point, the other lever-pin presses upon the end of the loop C, and opens the whistle in connection with it, indicating high water. It will be seen that, with this arrangement, we avoid the nuisance arising from the float-wire passing through the boiler-top, which, in case of high-pressure, is very troublesome. The parts, as here sketched, might be considerably modified; for instance, small brass chains might be substituted for the wire loops; or the whistles might be dispensed with, and the steam allowed to escape from the valve at once; or the valves may be placed externally, in which case the lever-pins must act upon the upper ends of the loop.



Leeds, June 11*th*, 1849. F. H. P.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

Tuesday, June 12, 1849.

Joshua Field, Esq., President, in the Chair.

"Description of the Construction of a Collar Roof, with arched trusses of bent timber, at East Horseley Park," by the Right Honourable the Earl of Lovelace, Assoc. Inst. C.E.

The roof, which covered a hall of fifty-six feet long by twenty-four feet wide, was described as being sustained by four arched trusses, springing from stone corbels. The ribs of these were each composed of four layers of deals, three inches thick, bent to the required form by steam heat. All the mouldings surrounding the tracery were also bent to the required forms in the same manner, thus giving great strength and lightness, as well as performing the work with greater economy of labour. The tracery was cut out from two thicknesses, half an inch each, of tub-stave oak, glued together, with the fibres at right angles to each other, which facilitated the carving, and gave greater strength to the minute tracery.

The ceiling was formed of half-inch diagonal boarding, and as the slate battens crossed it in a horizontal direction, the roof was strongly braced against the action of wind, and the staining of the alternate boards gave a pleasing variety of effect.

This kind of construction was first suggested by Colonel Emy, in his work on Carpentry, but he had applied it to much flatter roofs of large span, whereas Lord Lovelace's intention was to demonstrate its applicability to roofs for edifices in the pointed and Tudor styles, and to shew that great advantage would result from bending timbers, rather than cutting them to the requisite forms; that the thrust of the roof might be entirely taken from the upper part of the walls, and carried far down them, and that such a construction might be adopted as would satisfy every condition of solidity, and, at the same time, admit of considerable decoration.

In the discussion which ensued, the ingenuity of the design and of the mode of execution of the roof were equally approved, and the noble earl was deservedly complimented for the motives which induced him to bring to the Institution this account of one of his works.

"Statement of Observations made on the Initial and Terminal Velocities of Trains in descending Inclined Planes," by Captain W. Moorsom, M. Inst. C.E.

The observations were eighty-two in number, and were made during the ordinary passing of trains on the Waterford and Kilkenny Railway, the guage of which is 5 feet 3 inches, over two adjoining inclines, each falling at the rate of 1 in 100 for upwards of a mile and a half, with a short intermediate level between them.

The speeds at which the descent was begun, varied from 20 to nearly 44 miles per hour, and the loads varied from 32 to 94 tons.

One of the planes presented, for the greater part of its length, two curves of a radius of $1\frac{1}{4}$ and $1\frac{1}{6}$ miles respectively; and the other plane was straight for part of its length, but contained a curve of $2\frac{1}{2}$ miles radius.

The general results in the plane of greater curvature were, that initial velocities of 20 to 30 miles per hour, at the top of the plane, became terminal at velocities of 24 to 28 miles per hour; and on the straighter plane the same initial velocities became terminal between 29 and 31 miles per hour.

Again, on the former, initial velocities between 30 and 40 miles per hour, became terminal at velocities between $29\frac{3}{4}$ and $31\frac{1}{2}$ miles per hour; and on the latter plane, the same initial velocities became terminal at $30\frac{3}{4}$ to $33\frac{1}{2}$ miles per hour.

Initial velocities above 40 miles per hour were noted only upon the plane of greater curvature, and became terminal at 30 to 31 miles per hour. There did not appear to be any constant proportion between the load in motion and the terminal velocity; but the latter appeared to be dependant more upon initial velocity than upon the weight or character of frontage of the trains.

The general practical conclusion was deduced, that the question of guage had little or nothing to do with terminal velocity derived from gravity, and that the views generally entertained by engineers, during past years, of the great resistances experienced by trains at high velocities were borne out by the observations recorded in the paper.

The proceedings of the evening concluded with a paper by Lieut.-Col. Harry D. Jones, R. E., M. Inst. C. E., descriptive of the bridge at Athlone, erected under the authority of the Shannon commissioners, from the designs of Mr. Rhodes, M. Inst. C. E.

The paper described the great difficulties experienced from the rush of water into the coffer-dams, through the porous gravel stratum in which they were placed, and the ingenious modes of overcoming these impediments. The bridge, of three arches of stone and one of iron, the latter having the means of opening for the navigation, was fully described, and was admitted to be not only a beautiful structure, but to have been built for a small sum (about £24,000) considering its extent. A beautiful set of drawings, and the printed specifications for the work, illustrated the paper.

The paper announced to be read at the meeting of Tuesday, June 19, was "On the employment of High-pressure Steam for Marine Engines," by Mr. John Seaward, M. Inst. C. E.

Tuesday, June 19, 1849.

Joshua Field, Esq., President, in the Chair.

In the course of the evening, the Earl of Rosse, President of the Royal Society, was presented by Mr. Rennie to the President of the Institution, on his election as an honorary member.

"On the Employment of High-pressure Steam, working expansively, in Marine Engines," by Mr. John Seaward, M. Inst. C. E.

This communication was described to be the substance of a reply, by the author, to some questions addressed to several eminent engineering firms, by the Hon. H. L. Corry, M.P., when Secretary of the Admiralty. This reply was found to furnish so much useful information, and so completely to open the question of the advantage or disadvantage of using high-pressure steam, and of cutting off the steam at various portions of the stroke, that it was conceived it would be advantageously produced at the Institution, in order that the subject should be fully discussed. Unfortunately, the absence of the principal members at the floating of the first tube of the Britannia Bridge frustrated the latter expectation, but the substance of the paper appeared to be fully appreciated.

The argument was so continuous that it would be difficult to attempt to do more than to give a faint idea of it, as the limits of this account would not suffice for an abstract of it.

It first reviewed the mode of working marine engines for some years past, and noticed the gradual change that had occurred, particularly the tendency to use high-pressure steam, instead of that of a pressure of about four pounds above the atmosphere. It then examined the system of cutting off the steam at various parts of the stroke; and as, at the same time, a remarkable augmentation had occurred in the speed of the vessels, which was naturally attributed to that cause, it inquired minutely into these several causes and effects, as well as the considerable reduction in the consumption of fuel which took place, enabling the vessels, consequently, to make longer voyages, or to carry less fuel for given distances.

In this examination, all the arguments for and against the use of high steam, and the presumed gain or loss of mechanical power in the use of the expansion principle in the cylinder, were canvassed at length; and the paper wound up with the replies of the author to the three questions from the admiralty, to this effect:—

"The highest pressure of steam that we have, in any case, put upon a marine boiler of our own construction, was about 16 lbs. to the square inch; but we are not inclined to repeat the experiment, as we feel assured that we can obtain equally good results with steam of a lower pressure—from 10 to 12 lbs. is the usual pressure we employ in the merchant service for engines and boilers of comparative small power.

"The steam pressure at present employed in the service is about 8 lbs. per square inch. We consider steam of this pressure to be well adapted for the exigencies of the service; we believe it is calculated to secure all the important advanges of power, economy of weight and space, in a very eminent degree; these advantages will in some respects be slightly increased by augmenting the steam pressure to 10 or 12 lbs. to the square inch.

"We strongly recommend that the steam employed in the navy should not be of greater pressure than 10 lbs. per square inch, or in extreme cases 12 lbs. to the square inch; any material increase to the latter pressure will be attended with considerable risk, without any adequate advantage."

In the discussion which ensued, these propositions were to a certain extent concurred with, but with limitations as to the introduction of other forms of boilers; and it was explained that the arguments of the paper were only applicable to condensing engines working expansively, and therefore left the question of the introduction of the use of high-pressure non-condensing engines quite untouched and free for discussion at a future period.

Tuesday, June 26, 1849.

Joshua Field, Esq., President, in the Chair.

"Observations on the Obstructions to Navigation in Tidal Rivers," by Mr. J. T. Harrison, M. Inst. C.E.

The first part of the paper treated, in a general manner, of the circumstances affecting the deposition of materials and the action of water upon them; and in the latter part an application of these circumstances was made, in explanation of the formation of obstructions existing in the bed and at the entrance of tidal rivers.

Under the former head, the materials forming obstructions were first examined, the places whence they were derived, and the causes affecting their initial removal; cohesion, friction, the specific gravity and size of the materials, were shown to affect the question of their motion. The action of water upon these materials formed the latter part of the subject. Under this head, the character and effects of pure stream motion and forced motion, in the form of a pure wave of translation, and of standing waves, were severally considered. It was shown that, during pure stream motion, the water had the greatest velocity where the channel was deep; that curves in the channel gave rise to increased depth and velocity; and an explanation was given of the deposit of materials by the water after leaving a curved channel; that the effect of a pure wave of translation was, to scour the shallows, and deposit the material in the deeps; and, as its momentum was destroyed, to heap up a bank, rising gradually. The effect of standing wave motion of water was shown to be the formation of a succession of deeps and shallows.

Under the latter head, the *first division* treated of the action of river water—1st, in its own channel, when the subject of impediments, as piers of bridges, weirs, &c., was examined; 2d, where it discharged into a large basin devoid of tide, under which head the formation of deltas, &c., was discussed; 3d, when the basin into which it flowed was subjected to a rise and fall of tide, but without perceptible current.

The second division treated of the action of the sea without the entrance of the river. Attention was drawn to the effect of the situation of the entrance, with respect to the direction of the tidal wave. It was shown that, in some cases, part of this wave set directly up the river, as in the case of the Severn, &c. As a branch of this subject, the peculiarities of the tidal action, described in a communication to the Royal Society by Captain Beechy, as existing in the Irish Sea, were commented upon, and an explanation offered of some of them. In other cases, the tidal wave setting at right angles to the direction of the river, when the wave which passed up it was generated at the entrance. The deposition of materials near the mouth of rivers by along-shore currents, and by the wind-waves, was then briefly touched upon.

The third division treated of the action of the water in entering rivers, so placed that the wave was generated at the entrance. The circumstances which affected the quantity of water entering were considered; it was shown to be limited by the width and depth at the entrance, and the rise of the tide; and, again, by the degree of freedom with which the momentum generated is transmitted. It was also shown that this freedom of transmission depended chiefly on the depth of the water; and other circumstances affecting it were explained.

Under the fourth division, the removal of bars by the ebb tide was discussed; and the propriety of water having a free motion, and not being forced over the bar, was shown. It was argued, that bars are frequently increased by a narrow or shallow channel at the entrance causing a head of water, and the consequent formation of a standing wave between it and the bar. The deeper the channel could be maintained, and the further the water could be made to flow up it, the better would be the effect of the ebbing waters upon the bar. It was shown that the deep water found within the entrance of many rivers is caused by the flood tide, and that an improvement in the bar would probably have the effect of lessening this depth, which, in many cases, would be considered a disadvantage.

The fifth division treated of the effect produced on the bed of the river's channel. The difference in the motion of the water on the flood and ebb was shown. When the tidal wave was oscillatory at the entrance, the tendency of the tidal action was to draw out to sea the material lying in the bed of the channel at the entrance, and to heap up sand banks in the upper part of the estuary. When the tidal wave was generated at the entrance of a bottle-necked estuary, the formation sand-banks within the entrance, with the false channels which accompany them, was explained, as being the result of the flood tidal action. The effects produced by the ebb tide were shown to be generally similar to those described as produced in rivers proper.

The sixth division drew attention to the remedies necessary for preventing obstructions; and to that end it was urged that the sources whence the materials are derived should be first attacked; the possibility of checking the progress of shingle along the coast towards the mouth of rivers, and its entrance when there, as well as the washing down of the detritus from the upper part of rivers, was discussed; and it was agreed that much might be done by groyning the coast, carrying out piers at the entrances and in the upper part of the river, by groyning the banks in some places, and allowing a free scope for the deposit of the material which is being washed down in others. The subject of piers at the entrance of rivers was then more freely entered into, and the effects produced by their being built too close together and curved, were discussed. Some points which it seemed desirable to attend to in fixing the lines for confining rivers, were generally considered; and the paper ended with the expression of a hope that it might lead to discussion, and a further collection of facts, upon which alone any sound theory can be founded.

After the meeting, Mr. F. A. Carrington exhibited in the Library a beautiful model, in relief, of portions of the counties of Lancaster, Yorkshire, Cheshire, Notts, and Derbyshire, extending from Manchester to Lincoln; and the Humber, east and west; and from Leeds and Bradford to Chatsworth Park, north and south. These models show at a view the whole physical geography of a district, and are admirably calculated for projecting works of both civil and military engineering; and if they were a step in the sanatory improvements of towns, the progress would be more certain and less costly.

INSTITUTION OF MECHANICAL ENGINEERS.

ON THE CONSTRUCTION OF PERMANENT WAY.

By Mr. Hoby of Brighton.

The subject on which a few remarks are here offered for consideration, seems hardly to fall within the scope of this Institution; there exists, however, such an intimate connection between the construction and condition of the permanent way and the performances of the motive stock, as regards speed, economy, and safety, that little further apology need be made for the introduction of a few observations on the various kinds of permanent way now in existence.

The rapid deterioration of the permanent road on most of the leading lines of railway, since the introduction into general use of a class of engines considerably more powerful, and by consequence larger and heavier, than those in use four or five years ago, has been such as to attract the notice of the public, and to call forth the anxious attention of those on whom more immediately devolve the duties of engineering and management.

That there has been deterioration, more especially in the rails themselves, and that it has been lately manifesting itself far more rapidly than had been calculated upon, is evident from the additional strength now given by most engineers to the rails and other parts of the permanent way, in order that repairs may be less continuous, and renewals less frequent.

If the question be regarded in a general view as connected with economy, whether of first cost or annual maintenance, it will be manifest that these two points have an essential bearing on each other. A system of road may be expensive in its first construction, yet cost so little in maintenance, and last so long a time, as to be in the end far cheaper than a road less expensively formed, but requiring greater annual outlay, and more speedy replacement.

Circumstances being equal, the annual cost of maintenance distributed over a period of years, and including both labour and materials, should form a very distinguishing test to apply in ascertaining the merits or defects of the different constructions of permanent way now in use; for it may fairly be argued that the road which costs least to repair will also last the longest, a state of efficiency and security being presumed.

Acting on this view, the writer has endeavoured to collect such facts in regard to mode of construction, and cost of maintenance, on different lines, as might suffice, when collated, to determine the most advantageous, and ultimately economical, mode of construction, as well as to obtain some practical information as to the points wherein existing systems appeared weak or defective; and had intended simply to offer these facts, so far as they might be useful, for the consideration of the members of this Institution. But in pursuing this investigation, and attempting the proposed comparison, it became apparent that the cost of maintenance was controlled by elements not only not common to the different systems under consideration, but varying even on contiguous portions of the same line; these elements being, the nature of the substratum, or material of formation; the character of the ballast; and the extent and kind of the traffic,—circumstances which, whilst they render it difficult to arrive at any accurate average of the cost of maintenance on any particular line, make it impossible to deduce satisfactory results from a comparison of those averages.

It therefore becomes necessary to take up the question more at large, and to ascertain the conditions of stability and efficiency which are required in all permanent way, and the manner in which the various systems at present in use meet those conditions.

The principal of these conditions may be arranged as under:—

1. Sufficient platform or bearing surface on the ballast to prevent the whole road from being crushed down into the ballast.
2. Sufficient bearing surface of the various parts one on another to prevent their crushing into each other.
3. Sufficient cross ties to secure uniformity of guage between the two rails composing one line of rails.
4. Sufficient side stiffness in each rail.
5. Sufficient strength, quality, and shape of materials, to prevent their crushing in themselves.
6. Such general precautions as shall tend to the protection and preservation of the more perishable portions from atmospheric and other influences; on this last point, however, it will not be within our limits to enter.

These conditions satisfied, the questions of economy and simplicity of construction remain for consideration.

The bearing surface of the permanent road on the ballast has been variously provided. Amongst the more prominent of the modes now in use, we may notice roads laid upon—

1. Stone blocks.
2. Cross sleepers (of usual make.)
3. Cross sleepers (of usual make) brought nearer together at the joints, with a larger sleeper under the joints.
4. Cross sleepers of triangular section.

All of the foregoing usually sustain and secure the rail by the intervention of chairs.

5. The longitudinal bearer, used on the broad guage lines.
6. The same as laid on the narrow guage at London Bridge.
7. A combination of the cross sleeper with the longitudinal bearer now in use on the Midland Great Western Railway of Ireland, and formerly laid down on the Croydon line.

In these three plans, a flat-bottomed or a bridge rail is bedded on and secured directly to the longitudinal bearer.

8. And lastly, the system introduced on the South Coast lines, and on the Great Southern and Western of Ireland, in which a bridge rail is immediately fastened to cross sleepers. The cross sleepers in the case of the Southern and Western of Ireland vary considerably in size, and are placed at proportional distances, the great body of the support being under the joint.

Briefly to compare the amount of bearing surfaces respectively presented to the ballast under the several systems mentioned above, it will be found that, assuming a length of rail at 18 feet—

1. With stone blocks there are 1.33 feet super per foot run of rail.
2. With cross sleepers (of usual make) equally distributed, 1.12 feet super per foot run of rail.
3. With the same brought nearer together at the joint, 1.36 feet super per foot run of rail at the joint, and for 4 feet 1½ inch each side of joint; and 1.04 feet super per foot run of rail, over the 9 feet 9 inches remaining to make an 18 feet length.
4. With sleepers of triangular section rather more surface is presented to the ballast.
5. With that used on the broad guage lines, 1.25 feet super per foot run of rail.
6. With the longitudinal bearer used at London Bridge, 1.17 feet super per foot run of rail.
7. With the combination of the longitudinal and cross sleepers used on the Midland Great Western of Ireland, 1.43 feet super per foot run of rail; and in cases where more sleepers are introduced on boggy or peaty ground on the above line, or in the road on the Croydon line, 1.75 feet super per foot run of rail.
8. With the construction adopted on the Great Southern and Western Railway of Ireland, a general average of 1.50 feet super per foot run of rail; the proportions varying from 2.50 feet super per foot run of rail at joint, to 0.93 feet super per foot run of rail in centre of rail.

The next point for attention is the amount of bearing surface of the several portions of the permanent way one on the other, necessary to prevent their crushing into each other.

On instituting a similar comparison to the previous one, it will be found that, assuming as before an 18 feet length of rail—

1 and 2. With stone blocks and cross sleepers placed at equal distances apart, which may be regarded as the older forms of construction, when rather light chairs were used, there are 20 superficial inches per foot run of rail at the joint, and 17 superficial inches per foot on the remaining length.

3 and 4. With cross sleepers brought nearer together at joint, of usual make, or of triangular section, with large chairs, 23¼ superficial inches per foot run of rail at joint, and for 4 feet 1½ inch on each side of joint; and 16⅛ superficial inches per foot run of rail for the 9 feet 9 inches remaining to make up 18 feet.

5, 6, and 7. With the longitudinal bearer used on the broad guage lines and at London Bridge, and with the construction used on the Midland Great Western Railway of Ireland, and on the Croydon line, 60 superficial inches per foot run of rail.

8. With the cross sleepers to which a bridge rail is immediately attached, on the Great Southern and Western of Ireland, a general average of 16 superficial inches per foot run of rail, in proportions varying from 27 superficial inches per foot run of rail at joint, to 10¼ superficial inches per foot run of rail in centre of length.

It must be remarked, that in these last four instances, whether with bridge rails or flat-bottomed rails, packing plates are placed under the joints, and in the road at London Bridge at intervals along the rail, to prevent it from burying itself in the timber, more particularly at the joints; and that on the broad guage lines a packing of hard wood is introduced between the rail and the bearer, which presents to the longitudinal timber a surface of 108 superficial inches, or 0.75 super feet per foot run of rail, through which the fastenings for securing the rail pass.

The modes adopted for the preservation of the guage next claim our attention.

With stone blocks there is no provision for this beyond the stability of each individual block.

With cross sleepers this essential object is very completely secured.

With longitudinal bearers this point is secured by cross timbers with strap bolts; these bolts securing the longitudinal timbers hard up against the ends of the cross pieces.

In the case of the Midland Great Western Railway of Ireland and the old Croydon line, as has been before mentioned, cross sleepers are used with the longitudinals.

The next point for consideration is the side stiffness in each individual line.

With stone blocks and cross sleepers, whatever be the kind of rail used, the side stiffness depends entirely on the strength of the rail itself to resist lateral strain between the points of support.

The rails used with longitudinal bearers are in themselves very stiff laterally, whether of the bridge or flat-bottomed section, and their immediate connection with the longitudinal bearers gives a further amount of side stiffness to this construction.

From the foregoing remarks we collect that stone blocks, as a means of support on the ballast, although presenting a large amount of bearing surface on the ballast, and being in themselves solid and stable, neither retain the road in guage, nor secure the correct continuous elevation of the different points of support in the same line of rail; and as from this circumstance their use is chiefly confined to cuttings, where the substratum is hard, and the ballast good, their hardness gives a peculiar harsh and grating feeling to the carriages passing over them.

The situations now are comparatively few in which stone blocks can be procured for cost to surpass the wooden sleepers, especially when the labour of jumping and plugging the holes for the chair pins are taken into account. It is, however, to be remarked, that in cases where horse power is used they have the advantage of leaving a clear way for the horses' feet.

Cross sleepers, which have, on the narrow guage lines, been so extensively adopted, whilst presenting a very sufficient bearing surface on the ballast, unite in themselves a cross tie to preserve at every point of support uniformity of guage, and are readily packed and adjusted. Triangular-sectioned sleepers present theoretically a very large bearing surface to the ballast to resist downward pressure; it is, however, doubtful whether, except in ballast of a very firm and binding character, this effect is got from them, as in coarse and open ballast the sharp edge of the sleeper has a tendency to work downwards into the ballast with the motion of the trains, and to cant with the driving forward of the rails, a defect to which all cross sleepers are more or less liable. These last sleepers have the great advantage of being surface packed, so that repairs can be effected without the removal of a large quantity of ballast.

For side stiffness between the points of support, both with stone blocks and the various kinds of cross sleepers, the lateral strength of the rail is alone depended on; and in this respect the double T rails, so extensively used, seem open to some objection, for to their deflection sideways with an engine slack in guage, or travelling at a high velocity, may be attributed much of the side oscillation so observable at times, which a variation of speed will often check.

The writer is aware that it has not been usual to attach much importance to this question; and in Professor Barlow's valuable work, in commenting on the small amount of side deflection, as indicated by experiments in what were then considered most unfavourable circumstances, Professor Barlow says (page 421):—

> "The whole of these experiments" (on the lateral deflection of railway bars) "have a tendency to show, that the stress which the bars have to sustain in this direction is not such as to require to be more amply provided for than the increased thickness the bar must have to meet the greater vertical strain due to a longer bearing. In other words, the additional strength given to the bar for the purpose of resisting the vertical strain will be amply sufficient to meet and resist the lateral strain."

That is to say, the rails then experimented on were deemed strong enough laterally, and it was held that further increase of strength vertically, necessary for a longer bearing, or we may add, to support heavier loads, would suffice to impart the requisite lateral strength to the rails.

The weight of the engines, since Professor Barlow conducted these experiments, has been doubled and even trebled, the weight on the driving wheels more than doubled, and the speed, no unimportant element in producing side oscillation, has been almost constantly doubled, and on special occasions quadrupled; the weight of the rails has crept up from 45 or 50 lbs. per yard, to 75, 80, 90, and even 100 lbs. per yard, but the side stiffness has by no means proportionally increased.

In cases where even 70 lbs. rails have been tried with long bearings, the side oscillation has been found so constant and violent as to necessitate a recurrence to the shorter bearings most in use, from 3 feet to 3 feet 6 inches.

The longitudinal bearers have the advantage of presenting a continuous bearing surface to the ballast, and of giving with the rail great and uniform side stiffness to each line of rail, so that comparatively few cross ties are needed to keep the line in guage, those on the broad guage lines being 15 feet apart. To these two main features, continuity of bearing on ballast, and continuity and amount of side stiffness, are to be attributed the great ease and evenness of the motion of the engines and trains on the Great Western Railway.

This system of construction is open to the following objections:—The expansion and contraction of the rails tends to loosen the fastenings, especially at the joints; and from this cause, with the comparatively complex nature of the cross ties, the maintenance is more expensive than on ordinary roads laid on cross sleepers, and it seems difficult to lift this road without great care and attention. When a cross sleeper is used under the longitudinal bearer, securing at the same time correctness of guage and of the cant of the rail, this objection vanishes; and the cross sleeper being raised and packed, the longitudinal timber may be packed subsequently. This last construction, as used on the old Croydon line, stood a very large amount of traffic, although laid on substratum of a very inferior character.

Where a bridge rail is laid down directly on cross sleepers, the rail undoubtedly possesses in itself considerable side stiffness between the points of support; it does not however contain so much vertical strength to resist deflection as the ordinary double T rail, and the expansion and contraction of the rail is apt in cases to split the joint sleepers. The proportions in which, in the Great Southern and Western of Ireland, the bearing surface on the ballast is varied (from 2·50 feet to 0·93 feet super per foot run of rail), give so great a preponderance to the joint, that it may be doubted whether in practice it will not be found that constant packing is required in the centre of the rail lengthwise; and the amount of bearing surface of the rail on the sleepers is so small, that there will be much crushing of the rail into the timber, especially on the curves.

Having made these general remarks on the various peculiarities of some of the leading modes of constructing permanent way, it remains for us to consider the shape, strength, and quality of the materials used, to prevent them from crushing in themselves. This more immediately applies to the rails, or wearing surface of the permanent way. It is in this respect that most of the systems have alike suffered since the introduction of the heavy engines now in use.

The rails most in use vary from 2¼ to 2½ inches in width on the upper table or wearing surface, and are for the most part made rounding at the top. Now, if we look at the line of contact of a tyre on a rail, it will be found that a comparatively small portion of the width of the rail, in favourable cases not more than 1¼ inch, and in some instances less than ½ inch, is in actual contact. Now, if it be assumed that on a 5 feet 6 inch wheel of an engine in working order, a weight of 6 tons has to be carried, and if the strength of the iron in large railway bars to resist compression be taken at 8 tons per inch—(and it is doubtful whether more may be taken)—then the line of contact of the tyre on the rail in section being ¾ inch, it is obvious that such line of contact will have to be extended in the other direction into a surface of one inch, before the surface of the rail in contact with the tyre becomes sufficient to resist the weight superimposed, and the amount of compression in the rail will be represented by the versed sine of the chord of an arc 1 inch long with a radius of 2 feet 9 inches. The limit of compression of iron, such as is used in railway bars, being determined, it is evident that the amount of bearing surface between the rail and tyre will vary directly with the weight superimposed; that its extent in the length of the rail (or the length of the circumference of the wheel in contact) will vary with the length of the line of contact in section; and the extent of the compression or length of the versed sine, will vary with the radius of the wheel.

The amount of this permanent compression, or of the motion produced in the particles of the iron beyond the elastic limit, even supposing all the compression to take place on the rail and none on the tyres of the wheels, will evidently be infinitely small; but it may be fairly argued that such motion does take place, and renewed from time to time, from infinitesimal and insensible, becomes palpable and evident in its results.

It is difficult on other grounds to account for the rapid deterioration of rails, the word deterioration being used in contradistinction to destruction, as the rails now removed on some of the leading lines have in many cases lost little more than 2 lbs. per yard of their original weight, showing that, although rendered useless, they have not given out a fair amount of wear to the companies. For this information the writer is indebted to Mr. Dockray, and would take this opportunity of acknowledging the kind courtesy of that gentleman in permitting access to his very valuable report on this subject.

The cause of the removal of rails when not thoroughly worn out, is their becoming distorted in shape, such distortion being the result of lamination. Now this effect may be produced either from defective shape, or want of strength in the material itself to bear the superincumbent load. In regard to the usual T-headed rail, the impression very generally prevails that the shape is in fault, and it may readily be imagined that a rail of this make will gradually grow more distorted, from the pressure bending down the overhanging portions of the top table, without of necessity proving any motion to have taken place from absolute crushing. But bridge rails are found not to wear uniformly down (as they should do if no crushing took place); the upper corners of the rail turn outwards, and when the wearing part of the rail has been rolled or crushed out sideways, the centre part of the stop is driven downwards, and the sides turned completely over.

These observations would seem to confirm the conjecture previously hazarded, that under the weights now given to the engines, and with the limited extent of the tyre in contact with the rail in section, the rails themselves are gradually crushing; and remembering that the theoretical line of contact of the tyre on the rail in section must in all cases become a surface of greater or less extent, this effect is more to be attributed to engines with small-sized wheels used for goods traffic, than to the weight or speed of engines for express traffic, whose wheels are so much larger in diameter. And could the matter be investigated, it would be found that the rails suffered more from the passage of goods or mineral trains, than from that of passenger trains at whatever speed.

On the preservation of the perishable parts it would be beyond our limits to enter. Payne's process certainly has some effect in rendering the timber uninflammable, and therefore possesses advantage in the case of timber viaducts, or the planking of bridges. Saturating the timber with creosote, as adopted by Mr. Bethell, has produced very satisfactory results in preserving the timber from dry rot or decay.

Another example is given in a wide double T rail presenting a fair bearing surface to the tyre of from 2 inches to 2½ inches, and possessing considerable amount of side stiffness, being in depth 4 inches and in width 3½ inches, and weighing about 100 lbs. per yard.

The rail is secured by chairs to a longitudinal timber, 11 inches and 5½ inches, the chairs being sunk into the timber till the bottom surface of the rail is in contact with the top of the timber, along which a slight groove is cut, of such a shape that the rail shall bear harder on the outside edges of the groove than in the centre. Beneath the longitudinal timber are sleepers of triangular section placed immediately under the chairs, 2 feet 6 inches apart at the joints, and 4 feet in the centre of the lengths of rail, these last being supposed in lengths of 17 feet. The sleepers are cut out of 10-inch balk, and retain the road in guage, whilst presenting an additional amount of bearing surface on the ballast, and admit of being packed without much removal of the ballast. In fact, these sleepers offer peculiar advantages for this mode of construction, although any others might be used. The chairs are secured through the longitudinal timbers to the cross sleepers by hardwood tree-nails, the holes in the longitudinal timbers being bored slightly larger than those in the cross sleepers to prevent the timbers from splitting. The rails may of course be manufactured in such lengths as may be most convenient, and the cross sleepers distributed accordingly, and it may be found that the sleepers may be placed at wider intervals. The longitudinal timber is to be secured at the ends by a common half-lap joint, this joint to be always on one of the middle sleepers, and not under the joint of the rail.

A longitudinal timber 12 by 4 inches is used, and the chairs are not let in to the timber, but a saddle is introduced between the chairs.

The rails may be secured to the chairs either by a hard wood or wrought iron key; the latter of which is more efficient, as it is not affected by wet or dry, and it prevents the rails from driving forward in the chairs. The wrought-iron keys are more costly; but as in this case they are merely composed of short lengths of iron tube, the difference in expense would not be considerable.

There is a difficulty in replacing the chairs which will readily be seen by the members, but in practice this may not be found a very serious objection.

In the short discussion on this paper, the Chairman observed that it was a question whether the surface of the rails was actually suffering from the crushing action mentioned by Mr. Hoby. It seemed as if they had reached the limit of their powers when they began to crush the material. In Mr. M'Connell's opinion, a greater breadth of bearing surface of the rails would not yield the advantage anticipated by Mr. Hoby, as it is difficult to keep the bearing of the wheels in a straight line, and extending over the whole rail surface.

The Chairman observed, that the rail was very considerably increased in thickness laterally, and appeared a strong rail, but it must be remembered that the strength was diminished in proportion to the square of the depth. He did not attach so much importance as the writer of the paper appeared to do, to the fact of the permanent way having deteriorated more rapidly in the last three or four years than previously. It was certain that, on the older railways, which had been at work for thirteen or fourteen years, the deterioration of the rails had been much more rapid during the last three years of the time than the first three years, but he thought the wear and tear of the present rails had been much overrated. It must be remembered that the present heavy engines had been increasing in weight, whilst the rails had been getting older and more worn; and he believed that the weight of the present engines had got pretty nearly, if not quite, to the feasible limit.

Mr. Woodhouse remarked there was an objection to the proposed plan, that broken chairs could not be replaced without taking the rail out, which would be very objectionable.

The Chairman observed, it would certainly be a serious objection if the rail had to be taken out in order to replace a broken chair—all practical men were averse to it. He thought the lip on the inner side of the saddles might be dispensed with, which would allow them to be changed without disturbing the rail.

ROYAL SOCIETY.—May 3, 1849.

The Earl of Rosse, President, in the Chair.

A paper was read, entitled "On the Reduction of the Thermometrical Observations made at the Apartments of the Royal Society from the year 1774 to 1781, and from the year 1781 to 1843," by J. Glaisher, Esq.—In this paper the author states that he has examined all the thermometrical observations which have been made at the Royal Society, with the view of ascertaining whether the diurnal variations at different epochs were in accordance with those which he had determined from the Greenwich observations, and which are contained in his paper published in the Philosophical Transactions for 1848. The result of this investigation was, that the corrections contained in the tables in his former paper were applicable to the observations of all the years since 1774. The author is led from these examinations to the conclusion,—1st, that the instruments used have been uniformly good; 2dly, that the observations have been faithfully recorded as read from the instruments; 3dly, that the readings have been taken with care with respect to the times stated; and lastly, that the observations were worth the necessary labour of reduction. He finds, however, that some of the more recent observations of the self-registering instruments are liable to some uncertainty. He states that the mean temperature of every month was determined in the first instance from the observations which had been made during the day, and secondly, from the observations of the self-registering instruments. Tables were appended, showing the monthly, quarterly, and yearly mean temperatures, with those of groups of years, and other tables exhibiting the departure of every individual result from the mean of all. The author concludes by stating, that hitherto the mean temperature at Somerset House has been estimated too high. He does not here enter into the investigation as to whether the temperature as now determined is too high for the geographical position and elevation of Somerset House, but proposes to do so, in a paper he is preparing with the view of connecting the Somerset House with the Greenwich series, and of bringing up all the results to the present time. He hopes also, at some future time, to present results from the barometrical observations arranged in a similar manner.

May 24, 1849.

"On the Direct Production of Heat by Magnetism," by W. R. Grove, Esq. The author recites the experiments of Marrian, Beatson, Wertheim, and De La Rive, on the phenomenon made known some years ago, that soft iron when magnetized emitted a sound or musical note. He also mentions an experiment of his own, where a tube was filled with the liquid in which magnetic oxide had been prepared, and surrounded by a coil; this showed to a spectator looking through it an increase of the transmitted light when the coil was electrized. All these experiments, the author considers, go to prove that whenever magnetization takes place, a change is produced in the molecular condition of the substances magnetized; and it occurred to him that if this be the case, a species of molecular friction might be expected to obtain, and by such molecular friction, heat might be produced. In proving the correctness of these conjectures difficulties presented themselves, the principal of which was that with electro-magnets the heat produced by the electrized coil surrounding them might be expected to mask any heat developed by the magnetism. This interference the author considers he eliminated by surrounding the poles of an electro-magnet with cisterns of water, and by this means, and by covering the keeper with flannel and other expedients, he was enabled to produce in a cylindrical soft-iron keeper, when rapidly magnetized and demagnetized, a rise of temperature several degrees beyond that which obtained in the electro-magnet, and which therefore could not have been due to conduction or radiation of heat from such magnet. By filling the cisterns with water colder than the electro-magnet, the latter could be cooled while the keeper was being heated by the magnetization. The author subsequently obtained distinct thermic effects in a bar of soft iron placed opposite to a rotating permanent steel magnet. To eliminate the effects of magneto-electrical currents, the author then made experiments with non-magnetic metals and with silico-borate of lead, substituted for the iron keepers, but no thermic effects were developed. He then tried the magnetic metals nickel and cobalt, and obtained thermic effects with both, and in proportion to their magnetic intensity. Some questions of theory relating to the rationale of the action of what are termed "the imponderables" and to terrestrial magnetism then were discussed; and the author concluded by stating that he considers his experiments prove, that whenever a bar of iron or other magnetic metal is magnetized, its temperature is raised.

June 7, 1849.

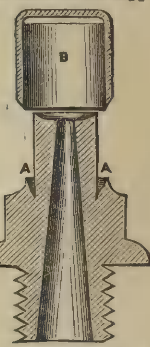
At the annual meeting for the election of Fellows, the following gentlemen were chosen:—J. C. Adams, Esq., T. Andrews, M.D., R. A. C. Austen, Esq., C. Bury, Esq., B. C. Brodie, Esq., J. Dalrymple, Esq., J. Glaisher, Esq., Sir R. Kane, M.D., W. Lassell, Esq., H. B. Leeson, M.D., A. C. Ramsay, Esq., J. Scott Russell, Esq., F. Sibson, M.D., R. Stephenson, Esq., Lieut.-Col. P. Yorke.

June 14, 1849.

The following paper was read, "On Carbonate of Lime as an Ingredient of Sea Water," by J. Davy. Considering the manner in which cliffs consisting of limestone are worn away by sea-water in situations not favourable to the disengagement of carbonic acid gas; and, on the other hand, the manner in which sand is consolidated and converted into sandstone in other situations favourable to the disengagement of this acid gas, and the deposition of carbonate of lime (the cementing principle), in consequence, the author has been induced to make trials of the water of the ocean, in crossing the Atlanic, to endeavour to ascertain whether carbonate of lime is widely diffused through the ocean, or is an ingredient of sea-water at no great distance from land. The results of his experiments have been of a negative kind, seeming to show that carbonate of lime exists principally in seas, where its presence is most easily accounted for, and where, in the economy of nature, it may be supposed, it is most useful. The author describes also some trials which he made on sea-water in relation to the sulphate of lime it contains, which he found to be variable in quantity in different situations. He suggests the propriety of having more extended inquiry made on this point, believing that the results may be important in connection with steam navigation,—the injurious incrustation which is liable to form in boilers at sea, being composed chiefly of this compound.

MONTHLY NOTES.

Messrs. Brooks' Water-Tight Percussion Cap and Nipple.—A valuable improvement in fire-arms, which we are sure will be appreciated by all sportsmen, has been made by Messrs. Brooks & Son of St. Mary's Square, Birmingham. Our cut will explain the nature of the new plan, which consists in so forming the lower edge of the percussion cap, and the portion upon which it rests on the nipple, that the junction will be water-tight, and the action of the cap will be more certain than at present, with the old arrangement. The engraving gives a section of the improved nipple, with the cap in the act of being placed upon it. The nipple, instead of having a square shoulder, has an angular groove, as at A A, and the rim of the cap B is similarly grooved to fit into it, so that, when pressed down in its place, a water-tight joint is formed. The advantages of this are, that wet or damp cannot penetrate to the priming—the whole of the flame resulting from the explosion is driven into the breach—and the metal of the cap does not fly when the gun is fired. In the old cap, which is placed loosely on the nipple, three-fourths of the flame are lost at the sides, but as modified by Messrs. Brooks, the whole of it is made effectual, and consequently the gun shoots stronger and further—having, in this respect, the same advantage as the percussion principle, in comparison with that of the flint. The pillar or cone of the old nipple being larger than the cap, the slits in the sides are opened by the act of putting on, and through these openings moisture finds entrance. In the new nipple, the cone is a shade smaller than the cap, and the pressure which secures them in their place, arises entirely from the bevelled ring. This has also the effect of holding the edge of the cap, so that when the hammer comes down, the metal does not splinter, as is frequently the case, and thus a great source of danger to the user of the fire-arm is entirely removed. We have by us a cap which has been fired, and which shows how slightly its shape is altered by the explosion. Its lower edge is rather bent inwards, and the sides exhibit, in one part, a very minute opening; with this exception, it remains the same as before using.



Domestic Telegraph.—The extraordinary despatch of railways and electric telegraphs seems to gave given an impetus to the national character in economising time in an infinite variety of ways never even dreamt of a few years ago. A scientific member of the Society of Friends has rendered the novel material of gutta percha tubing subservient to an important saving of time and footsteps in the domestic circle. In consequence of the peculiar power possessed by this tubing for the transmission of sound, he has applied it for the conveyance of messages from the parlour to the kitchen. Even a whisper at the parlour mouth-piece is distinctly heard, when the ear is applied at the other end. Instead, therefore, of of the servant having to answer the bell, as formerly, and then descend to the kitchen to bring up what is wanted, the mistress calls attention by gently blowing into the tube, which sounds a whistle in the kitchen, and then makes known her wants to the servant, who is able at once to attend to them. By this means the mistress not only secures the execution of her orders in half the usual time, but the servant is saved a double journey.—*Daily News, July* 12, 1849.—[Mr.Whishaw first drew attention to the value of gutta percha for speaking tubes, in his exhibition of the Telakouphanon at the meeting of the British Association of last year, and he then clearly explained the adaptation referred to in this paragraph, as will appear on examining our report of the British Association's proceedings, page 165, vol. I. We do not therefore quite perceive how it can be said that "a scientific member of the Society of Friends has rendered the novel material of gutta percha tubing subservient to an important saving of time and footsteps in the domestic circle"—any more than it can be so said of a person applying to his own use—what was long ago not only conceived, but executed, unless indeed he can show that he anticipated the gentleman we have mentioned, and the wording and date of the paragraph do not lead us to such an inference. The superiority of gutta percha, as compared with metal, for speaking tubes, is scarcely so well established, as to induce the universal preference of the former, and as the cost is infinitely greater, its special claims are not so evident. Some six months ago, when we determined upon fitting up a tube in our own office, we found that, whilst the gutta percha dealer charged $10\frac{1}{2}$ per foot for his tubes of $\frac{1}{2}$ inch bore, the tinsmith's price for such tubes was only $1\frac{1}{4}$—the relative cost of each, for a length of 57 feet, being as 6s. 11d. to £2 8s. 8d. Probably gutta percha might convey the sound more distinctly, but tin answers our purpose. The chief advantage of the first, appears to be the facility with which it can be curved to pass round corners, and this is certainly of importance, inasmuch as the sound is less interrupted in its travel.—Ed. P. M. Journal.]

Collins' Improvements in Paper Machinery.—We have recently examined the working of a most important improvement in paper machinery, the invention of Charles R. Collins, Esq., of the firm of Edward Collins & Son, of this city, who has introduced it at their extensive paper works at Kelvindale. The plan, which is as simple as it is effective for its purpose, obviates a very objectionable feature in paper machinery—namely, the irregularity of the withdrawal of the water from the pulp, in passing along with the wire-cloth, and with no greater alteration of existing machines, than the substitution of a plain discharge pipe, in connection with the vacuum chambers, in place of the cumbrous and expensive pumps ordinarily employed. By the adoption of this arrangement, which has now been tested for several months in Messrs. Collins' works, paper manufacturers possess the means of obtaining a perfect regularity of vacuum at a merely nominal cost, and without the absorption of an atom of power in working. The details of the contrivance will be found at full length under the head of Recent Patents, in the present number.

Peculiar Action of Chloroform upon Collodion.—The new preparation of gun-cotton dissolved in ether, termed by chemists, collodion, is, as our own recent experiments show, acted on in a peculiar manner by chloroform. If a little collodion is poured into a bottle containing chloroform, it becomes, as it were, partially restored to its original fibrous condition, and floats on the top, presenting a remarkable and extremely rapid change from a pure and colourless liquid, to a thick, half plastic, half fibrous substance. Again, on pouring a drop of collodion upon the surface of water, instead of mixing or spreading at all, it remains in mass, and rushes about from side to side of the vessel with a continuous movement, reminding one of the well-known experiment with camphor. The motion continues for some moments, partaking both of the rectilinear and vibratory kind, first making a few revolutions on its axis in one direction, then taking a run off in a straight line, and afterwards revolving again the other way. During the movement, the cause of this peculiar action is seen in a constant gaseous discharge from the edges of the drop, which, as it bubbles out, gives the mass a turn in one direction or the other, according to the side upon which it is acting.

Grafftey's Registered Fastening for Shirt Collars.—We have just seen a new arrangement for fastening the ends of shirt collars round the neck, which appears to offer great advantages over the old systems of strings and buttons. It is by Mr. Grafftey, of Sydney Alley, Coventry Street, London, and is nothing more than a plain strap of linen, or other material, attached to one extremity of the collar, and fitted with a series of small semicircular discs, set in a sloping direction on the strap. When the collar is to be fastened, nothing more is necessary than to pass the end of the strap through a button-hole formed in the opposite extremity of the collar; the discs slip through whilst the strap is being drawn through to fasten it, but catch on the edge of the button-hole, and hold the ends of the collar together when drawn back. To release them, the particular disc which holds is pressed flat to the edge of the strap, and may then be passed easily through the hole. By having several discs set at short distances asunder, the collar can be adjusted so as to be tight or slack on the neck at pleasure. The plan is very simple and effective.

Boat for the Prince of Wales.—By command of His Royal Highness Prince Albert, Mr. H. G. Robinson, Captain Light, Captain Smith, R.N., and Mr. C. Manby, Secretary of the Institution of Civil Engineers, lately attended at Buckingham Palace to present a beautiful life-boat, constructed on a peculiar principle, for His Royal Highness the Prince of Wales. The following are the dimensions of the boat:—

	Ft.	Inches.
Length over all,	20	0
Ditto on the keel,	17	4
Breadth at the main thwart,	3	$2\frac{3}{4}$
Ditto at the back-board thwart,	2	$11\frac{3}{4}$
Ditto at the rowlock,	3	$7\frac{1}{2}$
Depth,	0	$11\frac{1}{4}$

She was built by Messrs. George Searle and Sons, of Lambeth, boat-builders to Her Majesty, and is constructed of bird's-eye maple, the linings, saxboards, and thwarts being of Spanish mahogany; her keel-band, stem bend, and rudder hangings are of bronze, the rudder of maple, with a carved yoke, gilt, and silk lines and tassels of crimson and gold colour. She is also fitted with an elegantly-carved chair, the seat of which is covered with crimson satin damask, with an elaborate pattern in raised velvet of the same colour, the back being supported by the Prince of Wales' feathers, carved in maple and heightened with gold. The rowing mat is of the same material as the cushion of the chair, and there is a small foot-ottoman of Utrecht velvet. The sculls are of mahogany, and very light. The boat, which is a "single sculling skiff," is lined throughout between the timbers with Captain Light's patent material, which gives to her all the buoyancy and other properties of a life-boat. In some recent trials of this principle on the boats for the Preventive Service at Deal, it was found to render them extremely buoyant, and at the same time to stiffen them very much under canvas; and as the hazardous services on which these boats are employed are such as to place them continually in imminent danger of being swamped, the adoption of this system, both for them and for the boats of H.M.'s service generally, would be of great value, and would tend to prevent loss of life and sacrifice of property. The experiments showed, that boats lined with Light's buoyancy material were capable of carrying a full complement of hands with much more dead weight than usual, and yet, when filled gunwale deep with water, they could not be submerged. The same principle has been extensively used in the construction of swimming belts, life-buoys, &c., and for the stuffing of yacht cushions, mattresses, &c.; and as the material used is merely light tough rushes, properly prepared, and only three-fifths the weight of cork, no injury can ensue from puncture or cutting, as with air cushions, or the destruction of the elasticity, as in the case of cork shavings. Two beautiful specimens of swimming belts and small life-buoys were presented with the boat, for the use of His Royal Highness. Since the presentation of the boat to His Royal Highness the Prince of Wales, Her Majesty and His Royal Highness Prince Albert have been pleased to convey their thanks to the gentlemen interested in the undertaking, and to signify "their approbation of the principle," as well as their admiration of the boat, which "they consider a beautiful specimen of skill in boat-building."

ENGLISH PATENTS.

Sealed from 15*th June*, 1849, *to* 18*th July*, 1849.

Elijah Slack, Orchard-street, Renfrew, North Britain, gum manufacturer,—"An improvement or improvements in the preparation of materials to be used in the manufacture of textile fabrics."—June 2d.*

Henry Mills Stowe, Bermuda, master of the brig *James*,—"Improvements in blocks and sheaves."—20th.

Alexander Francis Campbell, Great Plumstead, Norfolk,—"Improvements in wheels, ploughs, and harrows, steam-boilers, and machinery for propelling vessels."—20th.

William Combauld Jacob, Bread-street, London, warehouseman,—"Improvements in the manufacture of parasols and umbrellas."—20th.

Richard Archibald Brooman, firm of Messrs. J. C. Robertson and Co., Fleet-street, London, patent agent,—"Improvements in apparatus for transferring liquids from one vessel to another, and for filling bottles and other vessels with liquids."—(Being a communication.)—20th.

Charles James Coverley Griffin, Southwark, hatter,—"Certain improvements in military accoutrements."—20th.

Edward Lyon Berthon, clerk, bachelor of arts, Fareham, Southampton,—"An instrument to show the velocity of a ship or other vessel propelled through the water by wind, steam, or other moving power."—20th.

Samuel Colt, Trafalgar-square, Middlesex, gentleman,—"Improvements in fire-arms."—20th.

Henry Bessemer, Baxter House, St. Pancras, Middlesex, engineer,—"Improvements in the methods, means, and machinery or apparatus employed for raising and forcing water and other fluids."—23d.

Thomas Merchant, Derby, civil engineer, and Robert Harland, Derby, carriage-builder,—"Certain improvements in the construction of railway carriages."—25th.

George Benjamin Thorneycroft, Wolverhampton, iron-master,—"Improvements in manufacturing railway tyres, axles, and other iron, where great strength and durability is required."—26th.

Thomas Wood Gray, Limehouse, brass-founder,—"Improvements in water-closets, pumps, cocks, lubricators, and deck-lights."—26th.

James Nasmyth, Patricroft, Manchester, engineer,—"Certain improvements in the method of, and apparatus for, communicating and regulating the power for driving or working machines employed in manufacturing, dyeing, printing, and finishing textile fabrics."—26th.

James Leadbetter, Kirby Lonsdale, Westmoreland, brazier,—"Certain improvements in the method of raising water and other fluids, which improvements are also applicable to the propulsion of machinery, pumping of mines, and other similar purposes."—26th.

Walter Neilson, Hyde Park-street, Glasgow, engineer,—"An improvement or improvements in the application of steam for raising, lowering, moving, or transporting heavy bodies."—26th.

Christopher Nickels, York-road, Lambeth, gentleman,—"Improvements in the manufacture of woollen and other fabrics."—26th.

William Wilson, jun., Campbellfield, Glasgow,—"Improvements in cutting plastic tubes or tiles."—27th.

John Thomas Forster, Plymouth, master in her Majesty's navy,—"Improvements in the building of ships, boats, and other vessels, also in the manufacture of boxes, packing cases, roofs, and other structures requiring to be waterproof."—27th.

Edward Woods, Liverpool, Lancaster, civil engineer,—"Certain improvements in turntables."—28th.

Thomas Beale Browne, Hampers, Gloucester, gentleman,—"Improvements in looms and in the manufacture of woven and twisted fabrics."—29th.

Bram Hertz, Great Marlborough-street, Middlesex, gentleman,—"Improvements in, and an addition to, fountain pens."—30th.

Thomas Greenwood, Goodman's-fields, London, sugar-refiner, and Frederick Parker, New Gravel-lane, Shadwell, animal charcoal manufacturer,—"Improvements in filtering syrups and other liquors."—July 4th.

John Robinson, Paterson-street, Stepney, engineer,—"Improvements in machinery for moving and raising weights."—4th.

John Grantham, Liverpool, engineer,—"Improvements in sheathing ships and vessels."—4th.

Josiah Bowden, Liskeard, linen-draper, and William Longmaid, Beaumont-square, Middlesex, gentleman,—"Certain improvements in the manufacture of soap."—4th.

Sir Francis Charles Knowles, Lovell, Berks, bart.,—"Improvements in the manufacture of iron and steel."—4th.

Richard Archibald Brooman, 166 Fleet-street,—"Improvements in steam generators."—(Being a communication.)—4th.

James Mulbery, Parkersburgh, United States of America, machinist,—"Certain improvements in the slide-valves of steam-engines."—4th.

William Henry Wilding, New-road, Middlesex, gentleman,—"Certain improvements in engines, and in obtaining and applying motive power."—4th.

Robert William Thomson, Leicester-square, Middlesex, civil engineer,—"Certain improvements in writing and drawing instruments."—4th.

William Bush, Great Tower-street, London, civil engineer,—"Improvements in lamps and in lighting."—(Being a communication.)—4th.

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* Omitted from our list last month.

John Combe, Leeds, York, civil engineer,—"Improvements in machinery for heckling, carding, winding, dressing, and weaving flax, cotton, silk, and other fibrous substances." —4th.

William Henry Brown, Ward's End Wheel, Wadsley, Ecclesfield, York, steel-roller, —"An improvement in rolls for rolling flat and half-round file and other iron and steel." —4th.

Pierre Augustin Chauffourier, Regent's Quadrant, merchant,—"Improvements in castors."—(Being a communication.)—4th.

John Browne, Great Portland-street, Portland-place, Esq.,—"Improvements in apparatus to assist combustion in stoves or grates."—4th.

Henry Bailey, Wolverhampton, Stafford, chemist,—"Certain improvements in the construction of articles of wearing apparel, which improvements are also applicable to fastenings for the same."—4th.

Robert Weare, Argyle-street, Birkenhead, clock and watch-maker, and William Peter Piggott, Wardrobe-place, Doctors' Commons, mathematical instrument-maker,—"Certain improvements in electric batteries and in the production of light; also a mode of transmitting or communicating intelligence for the better protection of life and property; part of which improvements are applicable to other like purposes."—4th.

Richard Garrett, Leiston Works, Suffolk, agricultural implement maker,—"Improvements in horse-shoes, pugmills, drilling and thrashing machinery, and in steam-engines and boilers for agricultural purposes."—7th.

Edward Ives Fuller, Margaret-street, Cavendish-square, carriage-builder, and George Tabernacle, Mount-row, Westminster-road, coach iron-founder,—"Certain improvements in metallic springs for carriages."—7th.

Thomas Sedgwick Summers, Cornwall-terrace, Lee, Kent, lighterman,—"Certain improvements in fastenings for mouths of sacks and bags."—9th.

Robert William Laurie, Carlton-place, Glasgow, merchant,—"Improvements in means or apparatus to be employed for the preservation of life and property, such improvements, or parts thereof, being applicable to various articles of furniture, dress, and travelling apparatus."—9th.

John Goodier, Mode Wheel Mills, Manchester, miller,—"Certain improvements in mills for grinding wheat and other grain."—9th.

George Augustus Robinson, Long Melford, Suffolk, gentleman, and Richard Egan Lee, Glasgow, gentleman,—"Certain improvements in the manufacture of bread, and in the machinery and apparatus to be used therein; and also improvements in the regulation of ovens and furnaces, part of which improvements are also applicable to other similar useful purposes."—10th.

George Cottam and Edward Cottam, Winsley-street, Oxford-street, engineers,—"Improvements in machinery for cutting straw, clover, and hay, for grinding, for sawing wood, and in apparatus for ascertaining the power employed in working machines."—12th.

Reuben Plant, Holly Hall Colliery, Dudley, Worcester, coal-master,—"Improvements in making bar or wrought-iron."—12th.

Evan Leigh, Ashton-under-Line, cotton-spinner,—"Certain improvements in steam-engines, and also improvements in communicating steam or other power for driving machinery."—18th.

Thomas Walker, Birmingham, stove-manufacturer,—"Improvements in boots and shoes, and in the manufacture of parts of boots, shoes, clogs, and goloshes."—18th.

James Usher, Edinburgh, gentleman,—"Improvements in machinery for tilling land." —18th.

Andrew Peddie How, United States, now residing in Basinghall-street, engineer,— "An instrument or instruments for ascertaining the saltness of water in boilers."—18th.

John Holland, Larkhall Rise, Clapham, gentleman,—"A new mode of making steel." —(Being a communication.)—18th.

Samuel Cunliffe Lister, Bradford, York, Esq., and George Edmond Donisthorpe, Leeds, in the same county, manufacturer,—"Improvements in preparing, combing, and spinning wool."—(Being a communication.)—18th.

William Brown, St. James's, Clerkenwell, machinist, Henry Mapple, Child's Hill, Hendon, electric engineer, and William Williams, the younger, Birmingham, gentleman, —"Improvements in communicating intelligence by means of electricity, and improvements in electric clocks."—18th.

IRISH PATENTS.

Sealed from 20*th June*, 1849, *to* 21*st July*, 1849.

James Hamilton, London, civil engineer,—"Improvements in cutting wood."—June 28th.

Michael Loam, Treskerley, Gwennagh, Cornwall, engineer,—"Improvements in the manufacture of fuzees."—30th.

David Smith, New York, United States of America, lead manufacturer,—"Certain new and useful improvements in the means of manufacturing certain articles in lead."— July 7th.

William Newton, Office for Patents, 66 Chancery Lane, civil engineer,—"Improvements in the jacquard machine."—11th.

SCOTCH PATENTS.

Sealed from 22*d June*, 1849, *to* 21*st July*, 1849.

Walter Neilson, Hyde Park-street, Glasgow, engineer,—"An improvement or improvements in the application of steam for raising, lowering, moving, or transporting heavy bodies."—June 25th.

David Smith, New York, lead manufacturer,—"Certain new and useful improvements in the means of manufacturing certain articles in lead."—25th.

Edmund Grundy, Bury, Lancaster, woollen manufacturer, and Jacob Farrow, manager, —"Certain improvements in machinery, or apparatus for preparing wool for spinning, and also improvements in machinery, or apparatus for spinning wool and other fibrous substances."—25th.

Robert William Laurie, Carlton-place, Glasgow, merchant,—"Improvement in means or apparatus to be employed for the preservation of life and property, such improvements, or part thereof, being applicable to various articles of furniture, dress, and travelling apparatus."—25th.

Edward Hawkins Payne, Great Queen-street, Middlesex, coach lace manufacturer, and Henry William Currie, engineer,—"Improvements in the manufacture of coach lace, and other similar looped or cut pile fabrics."—July 9th.

Robert Urwin, Ashford, Kent, engineer,—"Certain improvements in steam-engines, which may in whole or in part be applicable to pumps, and other machines not worked by steam power."—9th.

William Wilson, Jun., Campbellfield, Glasgow,—"Improvements in cutting plastic tubes or tiles."—10th.

James Godfrey Wilson, Milman-row, Chelsea, engineer,—"Certain improvements in obtaining perfect combustion, and in apparatus relating thereto, the same being applicable generally to furnaces and fire-places, as also to other purposes where inflammable matter or material is made use of."—11th.

William Crofton Moat, Upper Berkeley-street, Middlesex, surgeon,—"Improvements in engines to be worked by steam, air, or gas."—16th.

William Kenworthy, Blackburn, Lancaster, cotton-spinner,—"Certain improvements in power-looms."—16th.

George Benjamin Thorneycroft, Wolverhampton, ironmaster,—"Improvements in manufacturing railway tyres, axles, and other iron, where great strength and durability is required."—16th.

Edward Ives Fuller, of Margaret-street, Cavendish-square, Middlesex, carriage-builder, and George Tabernacle of Mount-row, Westminster-road, Surrey, coach iron-founder,—"Certain improvements in metallic springs for carriages."—17th.

Peter Augustine Godefroy, Wilson-street, Finsbury-square, London, chemical colour manufacturer,—"Certain improvements in dressing and finishing woven fabrics."—18th.

John Grantham, Liverpool, engineer,—"Improvements in sheathing ships and vessels," —18th.

Joseph Eccles, Moorgate Fold-mill, near Blackburn, Lancaster, cotton-spinner and manufacturer, and James Bradshaw, and William Bradshaw, of Blackburn, Lancaster, watch-makers,—"Certain improvements in, and applicable to looms for weaving various descriptions of plain and ornamental textile fabrics."—19th.

DESIGNS FOR ARTICLES OF UTILITY.

Registered from 14*th June*, 1849, *to* 19*th July*, 1849.

June 14th,	No. 1923.	Southgate and Alcock, Watling-street,—"Portmanteau."
—	1924.	James Hardcastle, Firwood, Bolton-le-Moors,—"Calender for finishing muslins and other goods."
15th,	1925.	Barnabus Urry, Newport, Isle of Wight,—"Horse-rake."
—	1926.	Robinson and Bussell, Westmorland-street, Dublin,—"Arrangement of serpentine passages and valves for cornopeons, &c."
18th,	1927.	Edmund Spiller, Holborn-hill,—"Bachelor's kettle."
19th,	1928.	William Robinson, Leeds,—"Mangling and wringing machine."
21st,	1929.	Robert Frampton, Queen-street, Brompton,—"Wheel-plate."
22d,	1930.	Charles Burrell, Thetford, Norfolk,—"Hurdle machine."
23d,	1931.	William Henry Dupré, Jersey,—"Defiance windguard and true ventilator."
—	1932.	Henry Giller, Birmingham,—"The Gillerian stopper for decanters and bottles."
25th,	1933.	James Hashold Steere, Burton-on-Trent,—"Parts applied to diaper and shawl pins."
26th,	1934.	Jas. Joseph Brunet, Canal Iron Works,—"Refrigerating brasses."
27th,	1935.	Thomas Eldrid and James Atkinson, London,—"Whip parasol."
—	1936.	Andrew Whytock, Quickset-row, Kew-road,—"Shower-bath."
—	1937.	Charles Henry Osborne, Birmingham,—"Ladies' dress-fastener."
28th,	1938.	George Smith and John Kemp, Birmingham,—"Button."
—	1939.	George Smith and John Kemp, Birmingham,—"Button."
29th.	1940.	John Vickery Broughton and Co., Cliff Works, Wakefield,—"Pipe-moulding forceps."
30th,	1941	Edward Brooks and Son, Birmingham,—"Water-tight nipple and percussion-cap."
July 2d,	1942.	George Keith, Prince's-street, Leicester-square,—"Machine for dividing ice, salt, &c."
4th,	1943.	Dr. Ellis, Sudbury-park, Petersham,—"Graduated glass double aperient fountain."
5th,	1944.	Charles Hart, Wantage, Berks,—"Plough-head."
—	1945.	Thomas Evans, 24 Southampton-street, Strand,—"Fastening for collars, stocks, shirts, and fronts."
6th,	1946.	J. Davies, King's Head-court, Holborn, and Charles Maltley, Wood-street, Grey's Inn-road,—"Rotatory self-acting tobacco-pipe machine."
—	1947.	William Goose, Birmingham,—"Self-feeding apparatus for nail machine."
—	1948.	John Smith, Corven, Wolverhampton,—"Feeding apparatus for mills."
—	1949.	Edward Burgess, 16 St. John-street-road, Clerkenwell,—"Fire indicator and alarm."
7th,	1950.	George Harborow, Holborn-bars,—"Shirt-collar."
—	1951.	Insole, Jones, and Kimberley, Birmingham,—"Harness back-band tag."
9th,	1952.	Francis Edward Colegrave, Brunswick-terrace, Brighton,—"Constables' staff."
—	1953.	John Whitehead, Preston, agricultural machine maker,—"Tile machine expander."
10th,	1954.	John Jones, Duke-street, Liverpool,—"Tailors' symetrometer."
11th,	1955.	Thomas Allen, Radcliffe, Lancashire,—"Twine-box."
12th,	1956.	Simeox and Pemberton, Birmingham,—"Hinge and door for letter-boxes."
13th,	1957.	Walter Hart, New-road, Brighton,—"The Sikh buckle."
—	1958.	Deane, Dray, and Deane, King William-street,—"Alarum letter-box."
14th,	1959.	James Hardcastle, Firwood, Bolton-le-Moors,—"Calender for finishing muslin and other goods requiring such process."
—	1960.	Bedington and Docker, Birmingham,—"Solar shade for the outside of windows."
16th,	1961.	Victor D'Anglais, Elin Cottage, Lymington,—"Epicurean oven."
—	1962.	Charles Burrell, Thetford,—"Gorse machine."
—	1963.	Charles Burrell, Thetford,—"Corn-dressing machine."
—	1964.	John Heather, Bedford-court, Covent-Garden,—"Petticoat."
18th,	1965.	John Chubb, St. Paul's-churchyard,—"Railway strong box."
19th,	1966.	Charles Clarke, Birmingham,—"Letter-box plate, applicable also to door-knockers."

TO READERS AND CORRESPONDENTS.

E. W. Hull.—Will he first show us the fallacy of the argument with which he finds fault?—We are at a loss to know what he means by "throw the rods into such tension that when the tension on the rod *m, e,* is resolved into horizontal and vertical, the horizontal shall equal the tension, B, *e*." Our investigation does provide for the "additional strain." Supposing his assumption to be true, how does he get the expression

$$\text{A}.e' + \frac{\text{B}.e. \times e.o}{m.o}\,?$$

Mr. Cooper.—Want of space compels us to delay our notice of the Epicycloidal curves until next month.

W. J. Silver.—Our correspondent has since admitted that he was in error.

M'K. P. & Co.—Next month.

L. M., Glamorgan.—His query could not be answered in the small space at our command here. Let him read Robertson Buchanan on water wheels.

Mr. Beedle.—We are obliged to postpone the notes we had made. They will be given next month.

A. B., Merthyr Tydvil.—It is not an easy matter to point out a *best* work on either of the subjects. See our "Mechanic's Library," where the most modern works are noted as they appear.

Mr. Crichton, Edinburgh.—Next month.

W. D. D. F., Carlisle.—See Hann on the Steam Engine—lately reviewed in our pages, The demonstration required, is to be found in nearly every elementary work on the steam engine.

MOVEMENTS OF THE DAY.

IRISH BOG AS AN ARTICLE OF COMMERCE—MR. BARRY AND THE PALACE AT WESTMINSTER—BAKEWELL'S WRITING AND PRINTING TELEGRAPH—PROGRESS OF THE BRITANNIA TUBULAR BRIDGE—GOVERNMENT REPORT ON COALS.

When Dr. Kane penned his volume on "The Industrial Resources of Ireland," he committed, as the late proceedings of our legislative assembly show, a great oversight, in neglecting to bring forward a detail of the enormous intrinsic value of the bogs. This exposition has been curiously enough delayed to afford some scientific exercise to the members of the House of Commons, the bulk of whom were lately astonished by a disquisition on the subject from the O'Gorman Mahon. In giving his version of the matter, the honourable member referred to a letter addressed to himself by Dr. Waters of London, wherein he says, "A discovery has been made in Ireland which will materially enhance the value of landed property in that country. It consists in the aptitude of its millions of peat acres to produce, at a trifling expense, (little more than that of manual labour), oil, naphtha, naphthaline, muriate of ammonia, piccomar, pittical, candles, pitch, tar, and other principles, by a new process of distillation. These several materials were submitted to me some months ago by Mr. Owen; and, from what I have seen and tested, I have no hesitation in pronouncing it one of the greatest discoveries of the age, and one which will become a source of unbounded wealth. I can easily let you have a list of the several products derivable from the distillation; and you have my permission to give this most important matter whatever publicity you please. Some of the products have been seen by, I believe, the Marquis of Lansdowne and others here, and I know the Irish Court are already cognizant of the discovery."

According to the additional particulars furnished by the honourable member, the most unequivocal testimony, both to the accuracy of the science involved in Mr. Reece's (the patentee of the process) invention, and the facility of its practical application, had been furnished by M. Pellouse of Paris, (in whose laboratory the patentee made his preliminary experiments, and perfected his discoveries), whose reputation combined the highest attributes of science with eminent skill in application. Similar testimony had been afforded by Professor Liebig, Dr. Hodges, professor of chemistry in the Belfast Institute, and many other eminent chemists who had been consulted on the subject. Under the sanction of these authorities, the capitalists who preliminarily undertook the investigation of Mr. Reece's invention had, within the last three months, erected experimental works in Ireland on a scale of sufficient magnitude to test its merits. Their success had been complete in obtaining the products enumerated by the patentee, and in verifying the scientific testimony. It appeared that Irish peat was capable of producing oil of a superior quality equal to spermacceti; and whereas spermacceti oil cost £90 to £95 per tun, the oil from peat could be produced for the sum of £40 per tun. There would be an equal reduction of price in respect to every other article into which peat might be convertible. The hon. member here exhibited to the house a candle, which, he said, had been produced from a solid piece of peat, and which, he added, gave a light equal to the finest wax. (The candle, which had all the appearance of a waxen one, was handed across the table to the Treasury bench, where it was inspected with much curiosity by Lord J. Russell and other members of the Government. It was subsequently lighted in the house, and burned very steadily and with great brilliancy.) The hon. member proceeded to say that he had the guarantee of Mr. Owen, a gentleman who had already established a manufactory in Ireland, having amassed immense property in this country, and on the faith of whose word he would stake his character, that there was no foreign material in that candle, but that it was the produce of a piece of Irish peat. Under these circumstances, he thought he was conferring a great benefit on his country by calling the attention of the house to this matter, as, by so doing, he made known to the empire resources in Ireland which had hitherto been unknown. He trusted that the noble lord the member for Bath, who was acquainted with Mr. Owen, would favour the house with his testimony in reference to that gentleman's character.

On this appeal being made, Lord Ashley added the weight of his good opinion of Mr. Owen, with whom he had had some communication on the subject, and read a statement of the amount of valuable materials into which 100 tons of peat are convertible. This weight of peat, costing in its original state £8, with another £8 for labour involved in its conversion, is said to contain—

Carbonate of ammonia,.........	2,602 lb.,	value	£32	10	2
Soda,................................	2,118 lb.,	value	8	16	6
Vinegar,...........................	600 lb.,	value	7	10	0
Naptha,......	30 galls.,	value	7	10	0
Candles,...........................	600 lb.,	value	17	10	0
Camphine oil,....................	600 lb.,	value	5	0	0
Common oil,......................	800 lb.,	value	3	6	8
Gas,..	—	value	8	0	0
Ashes,...............................	—	value	1	13	4
Total,.......			£91	16	8

This glowing list of products does not exhibit the full value of the boggy localities, as assumed by the advocates of the scheme—for, after the peat is cleared away, the soil beneath is found to be of the most fruitful description, being saturated with ammonia, and in the best possible condition for cropping. What visions of wealth does this pretty theory open up! and what lucky fellows, the holders of the three millions of acres of Ireland's bog, would seem to be! It is almost a pity even to throw any doubts upon it; but we must be pardoned for making one or two little inquiries, for our own satisfaction.

In the first place, before the public had time to look into the matter at all, it comes out that Mr. Owen had not, as stated by Lord Ashley, embarked capital in the enterprise, still less had he received remunerating return. Next comes a series of letters, relative to a trial of a similar scheme, some three years ago, near Plymouth. At that time a company was formed amongst the merchants and tradesmen of the district, with an able chemist at their head; they leased the government premises on Dartmoor, formerly occupied as prisons for the French; erected steam-engines and distilling apparatus, with tramways across the moor, to the various bogs, where the best peat was obtainable; produced from it ammonia, naptha, grease, tallow, gas, and other substances; but, somehow, they did not produce money. The concern was an utter failure; and of the £20,000 put into the boggy moor, none has ever been recovered. No one appears to impugn the general correctness of Lord Ashley's statement; on the contrary, Mr. Oxland, the eminent chemist of Plymouth, gives the following table of the products from 100 tons of the Dartmoor peat, which is well known to be inferior to the Irish:—

Charcoal, 33 tons, ...	£33	0	0
Peatine, 100 gallons,................................	10	0	0
Common oil, 50 gallons,........................ ...	2	10	0
Naptha, or pyroscilic spirit, 30 gallons,.........	7	10	0
Acetic acid, 168 gallons, ...	16	8	0
Crude tar, or vegetable tallow 33 cwts., 14 lbs.,	16	10	0
Sulphate of ammonia, 7½ cwt., ...	5	12	6
Gas,..	8	0	0
Ashes,...	3	6	8
Total,.......	£102	18	2

The experiment was made upon 20 tons only; but to bring it to bear upon the first statement, the proportion upon 100 tons is given—100 tons being also used as fuel; and it certainly shows a rather remarkable approximation to the pecuniary value given in the Irish statement, although the products differ both in nature and quantity. Mr. Oxland, however, admits that the gas and ashes are hardly convertible into money in the neighbourhood of their manufacture; but the charcoal has been used with great advantage in the manufacture of edge-tools; also for the manufacture of steel, case-hardening iron, and, when ground to a fine powder, in mixing with the moulding sand of the iron-founder. The fine oil, to which Mr. Oxland has given the name of "peatine," has been tried as an illuminator; and some of it was burnt in a camphine lamp at a council meeting of the Duchy of Cornwall, held at Somerset House about the time of the experiments.

With the actual Dartmoor failure then before us, how are we to reconcile with it the attested fact of the existence of so much valuable matter in a material originally so worthless? Simply by showing how wide is the variance between mere theoretical philosophy, and commercial practice, which reduces everything to a stern pecuniary standard.

The whole story of the invaluable bogs hinges upon a patent obtained in January, 1849, by Mr. Rees Reece of London, for "Improvements in treating Peat, and obtaining products therefrom." According to Mr. Reece's specified process, the combustion of the peat is effected by the assistance of a blast of hot or cold air, and the resultant products are passed through a hydraulic main, and a series of condensing pipes—a deposit being left in the latter, from which "paraffine," both solid and liquid, is obtainable by distillation. The solid material is afterwards subjected to the action of stearine presses, to obtain an additional quantity of paraffine, the solid being mouldable into candles, whilst the liquid portion answers as lamp-oil.

In this patent, the inventor claims only the peculiar treatment of peat, in place of distillation, in conjunction with the system adopted for the purification of the paraffine, and, as far as the scheme goes, it is no doubt successful. But its pretensions are very different to those of the Irish affair, which have led to such erroneous conclusions. For instance, an attempt has been made to show that soda was obtained from the bog itself, whereas it really arises from the admixture of soda with some of the products of destructive distillation, for the obtainment of the leading return of the process—carbonate of ammonia. Again, the oil has been compared with sperm, when the fact is that it is hardly fit for lubricating purposes at all, still less is it comparable with sperm oil, which is the best known lubricator for the finest movements. We find also vinegar set down to the value of £7. 10s. in the 100 tons of peat. Now it is very evident that it is only where undecomposed wood fibre exists, that acetic acid is to be met with, and the amount producible requires better evidence than is to be gathered from the experimental trial of a few tons.

We might venture further on to question the reality of the value of the other products, but we shall now simply refer to the one-sided statement which gives the manipulatory cost at so low an amount. First, it was said that the expense was no more than the £8 for the peat, and the same sum for labour, when Mr. Oxland, who has a practical acquaintance with his subject, tells us that he uses as much more peat to heat the retorts, making an item of £8 on the wrong side of the ledger. In like manner many other expenses are overlooked, whilst the products are excessively exaggerated in value. Allowing that the amount stated could be produced, what guarantee have we that the present price of the several commodities would be maintained? But what says Dr. Kane?

"Not merely may we utilize turf in its natural condition, or compressed, or impregnated with pitchy matter, but we may carbonize it as we do wood, and prepare turf charcoal, the properties of which it is important to establish. The methods of carbonization are of two kinds. 1. By heating the turf in close vessels; by this mode loss is avoided, but it is expensive, and there is no compensation in the distilled liquors, which do not contain acetic acid in any quantity. The tar is often small in quantity, and the gases are deficient in illuminating power. Hence the charcoal is the only valuable product. Its quantity varies from 30 to 40 per cent. by weight of the dry turf. The products of the distillation of 1157 lb of turf, were found by Blavier to be—

"474 lb charcoal, or........................	41·1 per cent.
226 lb watery liquor, or.	19·3 "
7 lb tar, or...............................	6 "
450 lb gaseous matter, or..............	39·0 "
1157	100·0"

This is not particularly promising, and it adds one more witness to the greatly over-rated qualities of the moss.

The movement created by the ill-judged announcements which we have noted, may still be the forerunner of good to Ireland, for it will direct the attention of the capitalist to the reclamation of the endless bog wastes, so far of no value. According to Mr. Rogers, peat charcoal is a powerful disinfectant and deodorizing agent; it takes up the greater portion of the obnoxious gases of feculent matters, and is a valuable fertiliser. Again, according to Mr. Baylee, county Clare, bog land may be reclaimed at a cost of £7 per acre, so as to be fit for cropping. Some land reclaimed by this gentleman yielded, for the first crop, £10 an acre, the second, for potatoes, £40 an acre, the third £6, and now there is upon it a crop of potatoes, worth £20 an acre. If Ireland is to receive any permanent benefit from her bogs, it will be through the instrumentality of a well-directed series of agricultural improvements, rather than the alchemical retort of Mr. Reece, the products of which are to be looked upon only in the light of costly curiosities, instead of economically manufactured articles of commerce.

The New Houses of Parliament afford a case in point of the present very erroneous system adopted in settling the remuneration for the professional services of architects. It appears that, when the buildings were commenced, the commissioners of the woods and forests determined that £25,000 should be the amount to be paid to Mr. Barry for the work he was to undertake, and this was announced to him by letter in March 1838. For nearly a month after this date, Mr. Barry was silent on the subject. He then wrote to ask upon what grounds they had arrived at their determination, in order that he might offer some remarks upon it—at the same time stating, that the sum mentioned was very far short of the usual remuneration to architects, and "inadequate to the skill, labour, and great responsibility that will attend the execution of the work in question." The commissioners declining entering into any further particulars, Mr. Barry distinctly stated that he had no wish to do otherwise than bow to their decision. Nothing more is said for ten years, when the estimate for the completion of the works is called for, and the enormous sum of £72,000 is found to be charged for the architect's account—being the usual five per cent. upon the whole outlay—and all but three times the amount originally stipulated for. So the matter stands—making a very unpleasant business of the whole affair.

The extraordinary discrepancy between the original estimate and the sum now mentioned as necessary to complete the works, deserves some remark, inasmuch as, after making all reasonable allowances for the extension of the works, the difficulties of the foundation, and the experimental system of heating and ventilating of Dr. Reid, the excess of actual cost is still most enormous. The original estimate was a little over £700,000; but it now appears that the probable cost of completion, including the purchase of property, is estimated at £2,045,923. We are well aware that the original scheme bears no proportion in amount of work to the actual details of the building as executed, but the expense is just three times as great. Every one who has seen the building, must acknowledge it to be the most extraordinary work of modern times, and coupling this with the general features of the case, we are not disposed to make the least remark upon the amount of the architect's remuneration; but, as furnishing a good example of the peculiar and evidently unfair method of fixing that remuneration, it deserves pointing out. The absolute cost of a building can never afford a true estimate of the amount of the architect's labour or study involved in it. Of any two buildings, one may be a mere combination of plain walls, whilst the other exhibits the highest refinements of architectural taste—but as both cost the same amount of money, the architect is paid the same for each. But this disproportion of remuneration is not the greatest objection, for the system occasions a direct opposition of the interests of the architect and his employer, and it is obviously the better for the architect that the proprietor of the building should have a dear building than a cheap one.

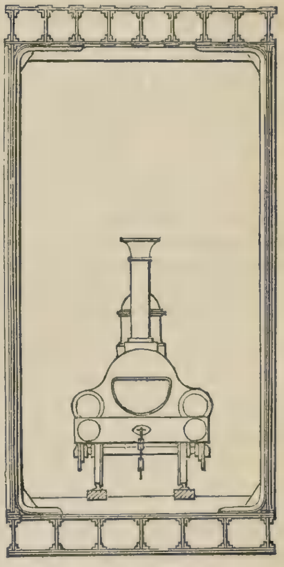
It is almost impossible to keep up with the ever-increasing stream of telegraphic improvements in connection with the doings of late years, in the adaptation of electricity as the actuating power of communication. According to a very recent patented invention of Mr. F. C. Bakewell of London, a party sitting here may actually write down his thoughts in London, with the same ease as on the paper before him, for the actual process of forming the communication—and in clear written or printed characters—is now reduced to a simple mechanical operation, requiring no initiation for its correct performance. The communication or message is written with varnish upon tinfoil or other conducting surface—or, conversely, the tinfoil may be covered with a non-conducting medium, to be afterwards removed by the tracing of a point over its surface in the act of writing, so as to expose the metal in the lines. This written message is then placed round the barrel of the communicating machine, and a corresponding machine, at the opposite end of the telegraphic line, carries upon its barrel the paper intended to receive it. This paper is well moistened with any solution readily decomposable by the electric action, so that a mark is produced upon it each time the circuit is completed. Equal parts of muriatic acid, water, and a saturated solution of prussiate of potass are used by the patentee; or, instead of this mixture, the paper may be simply saturated with the dilute acid, and after the message is written, it is brought out by dipping in a weak solution of red ferro-cyanate of potass.

The communicating instruments consist merely of a train of wheels acted upon by weights, as in clockwork, to give motion to the barrels, which, as they revolve, cause a metal style or point to traverse over their surface, by means of a screw-spindle carrying a nut on the end of a traversing arm, to which the style is fixed. As the barrel slowly revolves, the point is carried across from end to end, so as to cover its surface with close lines. The traversing points are insulated, and are connected with one of the wires from a voltaic battery, whilst the barrels are in connection with the other. Thus, whenever the point is pressed on the exposed tinfoil, the circuit is completed through the moistened paper on the receiving cylinder, and a mark is made upon it; but when it arrives at a part covered with the varnish writing, the connection is destroyed, and the marking ceases. It is therefore easy to see that, as the two cylinders gradually revolve, the traversing style of the receiving instrument draws a series of close spiral lines over the barrel, except in those places where the circuit is cut off by the intervention of the varnish; and if both barrels revolve accurately together, the transmitting point, in passing several times over different parts of the same letter, causes the receiving point to leave the letters on the barrel, white, on a dark-lined ground. The marking point of the receiving instrument is of iron or steel, when prussiate of potass or red ferro-cyanate is used as the solution for the receiving surface; and it is connected with the positive pole of the battery. When the tinfoil is entirely coated with varnish, and laid bare only by the writing point, then, of course, the received message is in lines across the letters, whilst the ground is left white.

It is essentially necessary, for the correct action of these instruments, that they each move accurately together, and the patentee has adopted an ingenious electro-magnetic arrangement for the accomplishment of this point. Each is connected with a pendulum, an electro-magnet, and a detached battery of small size. The wires in connection with these batteries are so arranged, that, as the pendulums vibrate, they form and break the electric circuit, bringing the electro-magnets into action once or oftener at each vibration. The keeper of each electro-magnet has an arm attached to it, the end of which almost touches the outer rim of the cylinder, where the keeper is attached to the magnet, and is raised from it by a spring when the magnetic action ceases. The outer rim of the cylinder carries several small projections, set at equal distances, and these rub against the end of the lever when it is drawn down by the magnet, but pass when it is raised. In working the instruments, they are so weighted that the cylinders rotate slightly faster than the speed they are intended to attain, so that the projections on the rim of the cylinder touch the bent lever before the electro-magnetic action ceases, and the movements of each instrument are regulated to correspondence by retarding the motion each time that the pendulums bring the magnets into action.

To copy print by these instruments, a portion of the ink may be transferred from the printed paper to tinfoil by pressure, or the tinfoil may be printed on at once from types. Greater speed of action may be obtained by using several points placed close together, but insulated from each other, so that the range of points covers a whole line of writing at once. Mr. Bakewell's ingenuity has brought forward many other clever features connected with the telegraphic system; but we have probably said enough to illustrate the value of the arrangement which he has adopted.

From the Report of Mr. Stephenson to the Directors of the Chester and Holyhead Railway, read at their recent meeting, we find that the works at the Britannia Bridge are in an advanced state, the masonry having been completed as far as practicable, previous to the floating of the tubes. Some delay has here occurred from a flaw in one of the large castings of the hydrostatic press in the Anglesea Tower. The leakage has, however, been stopped, and the tube, which we have previously noticed as having been floated to its position, is now being lifted by short stages, building up step by step with brick-work beneath its ends, so as to obviate all chance of risk from a failure of the lifting apparatus. A fracture which took place in one of the cross-heads of the Conway tube has led to the adoption of this process, as the only safe one, though it is productive of some delay. The arrangements for floating the next tube, which completes one line across the Straits, are being actively carried on, so that the lifting may be expected to commence during the first week of September, when advantage will be taken of the spring tides.



1 inch = 10 feet.

Our engraving, from one of Mr. Fairbairn's drawings, exhibits a transverse section of one of the Britannia tubes, taken within a few feet of the centre pier. It will be useful as giving correct details of the work, as actually executed; it shows also the relation which it bears to the locomotive-engine passing through it. The internal width is 14 feet; the depth of open portion, 26 feet 2 inches; and to this is to be added a depth of 1 foot 10 inches at top and bottom for the strengthening cells. The top ones are eight in number—being composed of plates 6 feet long, 1 foot 9 inches wide, and $\frac{12}{16}$ thick in the middle, decreasing as they approach the piers to $\frac{10}{16}$. The plates in the bottom are 12 feet long; they were made expressly for this purpose by Mr. Thorneycroft, the eminent ironmaster of Wolverhampton. The cells are here only six in number; their dimensions are 2 feet 4 inches, by 1 foot 9 inches.

We have to thank the present Board of Admiralty for at least one useful movement, which promises the best results. In the "Experimental Investigations on Coals suited for the Steam Navy," which they have authorised, their liberality has been well directed, for they have elucidated a body of facts of the first importance in reference to the economy of fuel. We published the first report at page 30, and the following numbers of our first volume; but the extent of the labours of the commission have rendered necessary the issue of a second report, now before us. Conjointly, the two productions embody a vast amount of practical information,—sixty-four British coals; five foreign coals, from Borneo, Formosa, and Chili; and four patent fuels, having been already examined; and more results are promised in a third report.

The object of the inquiry has not been simply to obtain data as to the greatest evaporative power of any given coal, under any single condition or circumstance; but, by taking into consideration each and every peculiar characteristic, to balance the whole, and determine upon the practical economic value for all purposes, and under all conditions. Under the direction of Sir H. De La Beche, and Dr. Lyon Playfair, the experiments have been carried on by Mr. J. A. Philips, who appears to have discharged his portion of the labour with the greatest assiduity and care. The fact of so careful an examination on so important a subject has caused much interest abroad; and the Academy of Sciences at Vienna has deemed the matter of such value, as to send a scientific man over here to examine the experimental apparatus, with the view of instituting similar tests in Austria.

In a future number, we shall give the chief results of the commission, as worthy of examination by all consumers of fuel.

ON THE PADDLES OF STEAMERS—THEIR FIGURE, DIP, THICKNESS, MATERIAL, AND NUMBER.

By Thomas Ewbank, Esq., New York.

(Concluded from page 104.)

The foregoing experiments and remarks relate chiefly to the *figure* and *dip* of paddles. Other traits next solicited investigation; and though neither prominent, nor promising any adequate reward for the requisite labour, they were thought worth attending to, since engineers will certainly be urged shortly to cast about for every means of adding, though ever so little, to the speed of steamers.

Buoyant or Displacing Paddles.

It had been imagined, that the resistance which fluids oppose to the sinking of bulky bodies in them, might be employed as an element of propulsion—that if close barrels, for example, were fastened to the arms of a wheel, their ends would act as paddles, and the force required to plunge them, (equal to 62 lbs. for each cubic foot of water displaced,) also react favourably on the boat. To test this idea, eight square and tight boxes, 7 inches by 7, and 6 inches deep, were secured to the arms of one wheel, and set to work against the eight blades, No. 1 (fig. 3), on the other. The boxes required, very sensibly, more power to carry them round than any other tried, and were miserably deficient in pushing the vessel forward with it—certainly not equalling four of the competing blades. They produced quite a commotion in the water, carried large quantities over with them, and, could we have communicated sufficient velocity, would probably have formed a vertical ring of it. These boxes were, and should be, considered simply as unusually *thick* blades. All paddles are buoyant in proportion to their thickness.

Thickness of Paddles.

But though worthless in one respect, they were valuable in another, for they led us to the fact, or the law, that the propelling virtue of blades expands and contracts with their thickness. Thicken them till they touch each other, and they form a perfect drum, which could exert no more propelling power than a revolving grindstone;—reduce them to the thinnest plates, consistent with the strains they have to oppose, and in the same ratio that property is augmented in them.

The boxes were removed, and boards, $\frac{7}{8}$ths of an inch thick, and 7 inches square, put in their places. These represented common plank paddles, and were found sensibly inferior to their metalline competitors, whose thickness was slightly less than $\frac{1}{16}$ inch. We next took away two of the latter, when no very obvious change in the boat's direction occurred. When two more were taken off, the remaining four were unable to contend with the wooden ones. These, it will be remembered, were $\frac{1}{7}$th the thickness of the boxes, and consequently inherited that proportion of their defects.

It was also very observable how much more water was raised by the boards than by the plates. It could not easily be cast off their blunt boundaries, but kept running over them, from one side to another—a fact rendered more distinct in the boxes. Nothing could declare plainer, that the sharper the dipping edges of paddles are made, the more back water they throw off at the point where its departure is most beneficial; that is, when the reaction favours the vessel's progress—and, consequently, less is carried higher than the axis. A very little labour would impart this feature—in other words, would make their section a wedge. The resulting benefit would repay the expenditure a hundred-fold.

Compared to metal, wood approaches in its nature to sponge: water clings to it; its pores are absorbing vessels, that suck it in, and assist to retain it on the surface.

Here nature also confirms the positions arrived at. Extreme tenuity of blade is stamped with perfection by her. Hence we see it strengthened by reticulated bars in the wings of insects—by radial, angular, and tapering ribs in the fins and tails of fishes. An uniformly thick and unsupported slab, like our paddles, is nowhere met with. We cannot imagine natatory or soaring organs formed after such a pattern, without feeling the absurdity.

The caudal propellers of fishes are necessarily thick where they join the bodies, but how rapidly is the substance diminished, and to a mere film, at their extremities; so much so, that they are often there torn and jagged, by accident or wear, as fishermen well know. There must, therefore, be some powerful reason for withholding the material—one that overbalances all inconveniences resulting from its absence; and what can it be but the thinner the blade, the more efficient as a propeller it is—the longer is its stroke, and the more effectual is the power that wields it. The same law prevails in the wings of birds; their outward boundaries are feathered off to almost nothing.

The reflection is irresistible. With what nicety and care nature perfects her propellers, and how clumsy and unfinished are ours; as if, forsooth, a vessel's progress did not depend upon them!

The last two experiments demonstrate, that the less water a paddle *displaces* by its volume, the more efficient it is; that all accumulation of material behind its acting face, beyond what is absolutely necessary to strengthen it, is injurious, and ought to be avoided. But how does this accord with the current practice? Oaken planks are universally employed, and I have heard more than one engineer assert, that the thicker they are the better! Because, said they, if their propelling property be not enhanced, it is not diminished, and their additional weight is a positive advantage, since the heavier the wheels are, the easier they work—the more uniform are their movements.*

The "Gorgon," an English steamer, had "large wheels and little power," so she used oak or pine scantlings, 5 inches by 6, or 6 by 8, for paddles. Had her managers been aware of the true effect of thick blades, they never would have adopted them with the view of economizing power.

Paddle planks vary in thickness from $1\frac{1}{2}$ to 3 inches. No sea steamers have them less than 2 inches. In the English vessels they are $2\frac{1}{4}$; in others, as the *Franklin*, they are $2\frac{1}{2}$; in some of the largest class they are 3. The *Atlantic* and the *Pacific*, each of 3000 tons, now building for the Collins' Line, are to have them 3 inches. The former is to have 28 blades; hence, united, they will form a solid mass, *seven feet* thick, in each wheel—just one-fifth of its diameter. They are to be $12\frac{1}{2}$ feet long, by 34 inches; those of both wheels will, therefore, contain nearly 500 cubic feet of timber, and must displace that enormous volume of water at every revolution, by their submersion alone!—and, as we have seen, not only uselessly, but with a serious retardation of the vessel's headway, and waste of her motive power.

The wheels of the *Pacific* are to be 36 feet in diameter; each will have 30 blades, $11\frac{1}{2}$ feet by 3 feet; the solid contents of her paddles will, therefore, equal 517 cubic feet. Her loss from the same source will, therefore, be greater. In *every* revolution of *each wheel*, her paddles will lose $7\frac{1}{2}$ feet of effective stroke, and those of the *Atlantic* 7 feet! Those of the ocean steamer *United States* are $2\frac{1}{4}$ or $2\frac{1}{2}$ inches thick; they are 36 in number, but as they are "split," and attached on both sides of the arms, there are really 72. They certainly diminish the effective strokes of her blades, from 10 to 15 feet, in every turn of her wheels, startling as the assertion is.

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* As a further indication that the value of thinness in blades, and of their disincumbrance from every pound of material extraneous to their functions as propellers, has not hitherto been appreciated, it may be remarked, that the same language was repeated in my hearing thus:—"A few tons of wood in the buckets do no harm, if they do no good; they add weight to the wheel, which is desirable, and their only disadvantage is, the additional load on the boat." I believe this is the general, if not the universal, opinion of engineers. But the experiments just referred to, teach us that, if a wheel require loading, the load should be attached to those parts of the arms that revolve above the surface. They cannot enter the water without becoming drags on the blades.

Has the attention of engineers ever been turned this way? Or have they forgotten, that a volume of water equal to that of a boat's paddles, and every inch of material submerged with them, is neutralized as a resisting medium, as often as it is displaced by their immersion;—that water is to them what steam is to pistons—the more space the latter occupy in cylinders, the shorter becomes their stroke, because metal then takes the place of steam; the object to be moved, crowds out the mover. Thicken a piston till it fills its cylinder, and the motive agent being wholly kept out, all motion ceases.

It is much the same with the paddles of a wheel. Let them fill up $\frac{1}{10}$, $\frac{1}{5}$, $\frac{1}{3}$, or $\frac{1}{2}$, of the circles they describe, and in those proportions they lose their virtue, because in the same proportion they displace, or push aside, the fluid agent on which their worth depends.

The *Atlantic* will lose *seven feet* stroke in every turn of her wheels. I leave to mathematicians to determine, how many more miles an hour she would make, if the loss were reduced to *seven inches*, by using $\frac{1}{4}$-inch iron in place of 3-inch plank.

There are several interesting questions about paddles that yet require solutions, but as respects their thickness, there is no *mean* to seek; the thinnest is the best under all circumstances—thin, were it possible, as a lamina of mica. The only question is, What material will supply the thinnest sheets to resist the pressure they are to oppose? Plates of steel, I opine, will yet be adopted.

To one remark, an examination of some steamers' wheels adds force. The accumulation of bolts, nuts, clamps, straps, stays, and other things, on and about the backs and faces of paddles—sometimes even to bolting a new plank, or part of one, over an old one—show that those who heap on matters of the kind, are not aware how much the efficacy of blades are thereby diminished. They forget that they should be thin and smooth as plates of glass, and that every inch of matter introduced between them is an evil. It is impossible to view the disjointed, broken, patched-up slabs of some vessels, without exclaiming, "What a saving of power, and increase of useful effect, would not the substitution of a suitable sheet of metal for each accomplish!"

A new division of engineering, I sometimes think, might judiciously be made, and paddle-making be recognized as a distinct department. These instruments have certainly never received the attention which they merit. Speed is the great desideratum, and it depends on them. Engines, and all the mechanism of a steamer, are subservient to them, and yet, while everything else has been elaborated to the utmost, they have been all but overlooked.

In some vessels—the United States mail steamer *Galveston* is one—strips of planks are bolted over the ends of the paddles to prevent their splitting or warping. As they do not diminish the faces, but merely form elevations upon them, they are doubtless considered as in no degree interfering with the propelling function. We now perceive that, when such things are necessary, they should be of iron, and let into the blades, so as to be flush with their surfaces.

Number of Paddles.

The experiments of each day convinced us that, so far as propulsion is concerned, the fewer the paddles, the faster went the boat, so long as *one* at each wheel, or an area equal to the face of one, was kept in full play. A greater number in the water merely cuts it into slices, throws them into commotion, and diminishes the resistance they should oppose to the blades. As a further elucidation of this fact, we tried, at the suggestion of Mr. B., four blades, 7 × 14, against the eight test ones, 7 × 7. The smaller number had a decided advantage over the greater, and the cause was visible: they had a full sweep, through an unbroken, undisturbed mass of fluid, and consequently produced, unabridged, their legitimate effects; while those on the other wheel—unusually small ($\frac{1}{3}$ or $\frac{1}{4}$) as their number was, compared to those on the wheels of steamers—following so quickly in the wake of one another, threw it into an uproar, causing eddies, whirlpools, and counter-currents, and thus interfering with each other, necessarily produced inferior results.

We thought eight of fig. 4 would be equally valuable as twenty-four of fig. 3, but the construction of our wheels prevented us from instituting a series of similar comparisons.

The number of paddles now employed is, generally, greater than formerly. For large vessels, 28 are usual; some have 24, and others 32. The English rule, said to be a good one, is adhered to by many American engineers, except when circumstances require a deviation. By it, there is a paddle for every foot of a wheel's diameter, which makes them stand three feet apart; there are boats in which they occur every two feet.

One object of their multiplication, is to equalize the jar of their striking the water, by increasing the number of their blows. With the same view, they are often split through the middle, lengthwise, and the inner half—that next the shaft—removed to the opposite side of the arm, as in the end view (fig. 25), thus *doubling*, in a manner, their number. All the British steamers have their blades thus arranged. The *Hermann's* 28 were thus made into 56; their efficacy was found to be reduced about 9 per cent. The value of the upper or inner halves has been ascertained to be about the same, for, when wholly removed, the lower portions have proved within 10 per cent. as effective as before. The blades of the *United States* are split, and disposed as in the figure. The true principle of breaking the jar of paddles striking the water, seems to me to be indicated in the blades 4, 5, 8, 9, 10, 14, 15, 20, 21, 22, 23, and 24. Had the attention of engineers been led to it in the early days of steaming, the popular plan of avoiding the evil at the expense of a greater would not have been sanctioned so long.

fig. 25.

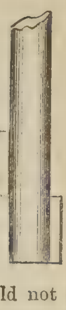
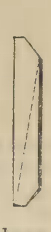


fig. 26.



I observed the blades of the last-named steamer, a week after her recent return from Europe. *Seven* were submerged, or *fourteen*, if those on both sides of the arms be counted. She sailed on the 4th inst. for New Orleans, with eight (or sixteen) under water. The *Cherokee* left on the 1st inst. for Savannah, with *six* of her undivided blades below the surface. The *Washington* came in on the 6th inst. from Bremen, with *five* similar ones fully immersed on each side—four full ones, and the halves of two others. The largest of our sound and river boats have equal, if not greater numbers under. The *Vanderbilt*, 1200 tons, has *five*, or *ten* halves, immersed in each wheel, when lying at her dock, and without passengers on board. The *Isaac Newton*, 1200 tons, has similar wheels, and the same number of blades under water at once.

It is clearly as impossible for a paddle to do its duty, when thus embarrassed among its fellows, as for a traveller to make the same progress through a crowd as on an open plain.

As sea steamers have little occasion to go stern-forwards, the backs of the acting faces are occasionally dressed off, as shown by the outline of fig. 26. As far as the lower or dipping parts are concerned, this is an advantage; but, from the preceding experiments, it is seen how much more beneficially such blades would act, were those parts brought to a knife-edge, and their sections bounded by the dark part of the cut.

Arms of Wheels.

The practice of making the arms of paddle-wheels of uniform, or nearly uniform, dimensions throughout, is also wrong. They may, without diminution of strength, be reduced towards their extremities, and ought to be, since every inch of surplus material submerged in them, detracts from the work done by the blades. They should taper outwards, as nature tapers the radial ribs in her propellers.

Coating Paddles with Materials that repel Water.

If any substance can be found, durably to prevent paddles from being *wetted*, they would then carry over less water with them. We coated one set with grease (suet), and, while the water streamed uniformly over the faces of others, it adhered only in narrow streaks to these.

Besides the paddles described, some others were tried, but as they involved different principles, and were not of very practical application, their introduction here is not necessary.

These results sustain but partially the views expressed in the article inserted in a former number of the Journal.* The form of blade there proposed removes but one evil.

The lessons which the foregoing experiments teach us are—

That, to render paddles of steamers more effectual, they ought to be fashioned, as far as circumstances sanction, after models furnished by nature, so as to conform to her general practice of contracting surface when resistance is of little avail, and extending it when the latter is greatest—to give the largest portions of blades the longest strokes.

That the fewer the paddles on a wheel the better, provided *one* be always kept in full play; and hence, that it would be more advantageous to point or fork them as proposed, to evade the jar of their striking on the surface, than so perniciously to split and multiply them, as the popular practice is.

That smooth and thin metallic plates should be substituted for the usual massive, water-soaked planks. (At present, perhaps, nothing better than boiler-plates, galvanized, could be adopted.) That bolt-heads, nuts, cleats, straps, and every other projection upon or about them, should be provided against. That the arms of wheels ought to be reduced at their outer extremities, and the immersion of all superfluous material carefully avoided. That, when wheels require balancing, or their momentum to be increased, the weights should be attached to the arms above the surface of the water.

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* Journ. Frank. Inst. Vol. XVI., p. 264.

To coat paddles, and parts that plunge with them, with varnish, or other substance that repels water, that the fluid, instead of being dragged up in volumes by them, may roll from them, as from the backs of diving birds.

Some persons smile at the idea of machinists studying nature; and such, on perusing the preceding suggestions, will deem it a sufficient reply, to remind the proposer, that steamers are not black fish, nor paddles salmons' tails, nor petrels' feet.

But minds, differently organized, think a glance into her workshops is never amiss, and that the longer the visit, the better for the visitor, since there is no art or contrivance (and it is certain that, through eternity, there never can be one) which has not its prototype in her collections. If we find them not, it is because of inattention, or of an imperfect acquaintance with her stores. Perhaps we know not at which of her ateliers to inquire, or are not prepared to appreciate specimens laid before us when we enter.

No person, of course, expects to find in living mechanisms exact copies for artificial articulations; but when a mechanical principle, and the instruments through which that principle is manifested, are before us —when we see motion communicated to a class of organs, comprehend their construction, effect of their forms, modes of their action, and dynamic results—there is no difficulty in making such deviations, as difference in materials, powers to be employed, and conditions under which the artificial machine is required to act, may require. It is the perfection of invention thus to *imitate* nature—the maturity of science and art to tread in her steps.

It would be wrong to close this paper, without acknowledging many obligations to Mr. John Bell of Harlem, by whose assistance the experiments were conducted; a gentleman whose judgment on general mechanics is not surpassed; and to Mr. Mott, for the use of a boat, and facilities for making the various paddles tested; to Messrs. Morris and Cummings also.

Mr. Bell has matured a substitute, which he proposes for paddle-wheels, consisting of two reciprocating arms on each side of a vessel. At their extremities are folding blades, or vanes, which open when sweeping in one direction, and close in the other. He dispenses with the cumbrous paddle-boxes, and leaves the deck nearly clear; at the same time increases the sweep of the blades beyond what is practicable with wheels, by simply elevating (on framework resembling that of beam-engines) the points of their suspension.

From Mr. Allaire, and from Mr. Stillman, the well-known principal of the "Novelty Works," were derived many valuable facts.

New York, November, 1848.

THE THERMOMETER AND THE PHENOMENA OF HEAT.

No. II.

The sun is the calorific source which incessantly tends to elevate the temperature of the globe and that of its atmosphere. If the sun did not exist, the globe and its atmosphere would radiate heat into the celestial spaces through which they move, and their temperature would fall until it reached that of celestial space. Fourier calculated that the temperature of the space within the limits of the solar system is not lower than 50° or 60° below zero, and he believed this calculation to be correct within 8° or 10°.

The less elevated the sun above the horizon, the more feeble is its heating power, because its rays cross a greater thickness of atmosphere, and many of them glance along the surface of the earth without resting upon it. Hence the coldness of the polar regions throughout the year, and of our climate in winter.

The *Heliothermometer* of Saussure affords us a means of measuring this gradual decrease of the heat of the solar rays. It consists of a box, coloured black, and formed of bad conducting bodies. A small opening in it is composed of one or more transparent plates of glass, behind which is placed a thermometer with a blackened bulb. The box is exposed to the sun in such a way, that its rays fall perpendicularly upon the opening, and heat the thermometer. It is always necessary to apply a slight correction to the results,—the thermometer being affected not only by the direct rays of the sun, but also by the actions of the surrounding medium, the heat of which penetrates in some degree through the sides of the box. To ascertain the quantity of this heat, we interpose an opaque body, such as a plank of wood, for a minute between the sun and the instrument. Now, suppose the thermometer to rise 0° 6′, the screen is removed for a minute, and under the direct influence of the solar rays it rises 2°; the screen is then replaced, and in the space of a minute it rises 0° 2′. It is therefore evident, that during the second minute, when it was exposed to the solar says, it rose by reason of the temperature of the surrounding medium $\frac{0^\circ.6+0^\circ.2}{2}$, and consequently only $2^\circ-0^\circ.4=1^\circ.6$, by reason of the action of the solar rays.

The atmosphere absorbs a great part of the solar rays, and it is probable that, during a calm day, no more than one-half of them arrive at the earth. Consequently, when we take into account the days when clouds are numerous, it is evident that only a small number of the solar rays are employed in heating the ground. It is true that clouds prevent radiation, and therefore to that extent they hinder the cooling of the earth.

Besides the heat which it receives from the sun, there is the proper heat of the earth. The more deeply we penetrate into the earth, the more elevated do we find the temperature. Observations differ a good deal as to the rate of increase, but the mean appears to be a degree of Fahr. for each 94 feet.

The variations of the earth's temperature arise from three causes:—1st, from the position of the earth with respect to the sun at different seasons, so that at one period heat is propagated from without into the interior, at another it moves from the interior to the surface: 2d, from the tropical regions slowly transmitting heat towards the poles, where it escapes into the atmosphere and the exterior space: 3d, from the secular cooling of the earth from every point of its surface. With respect to the last cause, however, since there is evidence that, during the last 2000 years, the day has not been shortened, even to the extent of the hundredth part of a second, and since the volume of the earth must determine the time of its rotation, it has been concluded that the earth has not cooled the 300th part of a degree of Fahr. in that space of time.

In summer, clear days are warmer than cloudy days. In winter it is the reverse. During summer when it rains, the water, falling from an elevated part of the atmosphere, cools the air by absorbing its heat, and the ground is cooled by the succeeding evaporation—hence the fall of temperature observable after tempestuous rains. These phenomena are especially to be remarked between the tropics, where the rainy season frequently coincides with the period when the sun is at the zenith. In winter, on the contrary, the rain is often warm by comparison with the air and the ground.

The influence of the wind on the temperature is very well known. In the south of England the north wind is the coldest; the warmest is that of S. 12° E. At Paris, the coldest wind is the N. 18° E. and the warmest the S. 17° E. The state of the sky and local circumstances sometimes interfere with the operation of general rules.

The following table will give an idea of the extreme variation of the temperature in different places:—

Places.	Minima.	Maxima.
Surinam,	70°.3	90°.0
Pondicherry,	70°.3	112°.5
Madras,	63°.0	104°.0
Martinique,	62°.7	95°.0
Grand Cairo,	48°.3	104°.3
Rome,	23°.0	87°.3
Cambridge, (U. S.)	12°.0	92°.3
Padua,	4°.0	97°.3
Prague,	16°.5	95°.7
Copenhagen,	0°.0	92°.6
Moscow,	0°.38	89°.6
St. Petersburg,	0°.28	91°.0
Fort Reliance,	0°.69	——

It appears from this table, that in the cold meridians they have hot summers and cold winters; whilst in the warm meridians the temperatures of the two seasons are much less widely separated.

The highest temperature that has been experienced in the open air was noticed by Burckhardt at Esne, in Upper Egypt; it was 117°. The lowest was noted by Back in crossing North America in order to join Captain Ross; it was—69°, the difference is 186°. Thus, man can bear a difference of temperature greater than that between boiling and freezing water. We see that there is a much greater difference between the lowest temperatures than between the highest, and it is therefore chiefly the cold of winter which lowers the mean of the northern regions. In the open sea, the temperature has never been observed higher than 88°.

The farther we retreat from the sea-coast into the interior of the land, the greater difference do we find between the mean temperature of summer and that of winter. The following table gives the mean of summer and winter, and their difference for several places on the sea-coast in the British islands:—

Places.	Winter.	Summer.	Difference.
Feroe,	39°.2	52°.8	13°.6
Unst (Shetland Isles),	39°.3	53°.4	14°.1
Aberdeen,	37°.9	58°.1	20°.2
Edinburgh,	38°.1	57°.2	19°.1
Isle of Man,	40°.86	57°.56	16°.7
London,	39°.12	62°.32	23°.2
Torquay,	44°.05	61°.26	117°.21

We see that in none of these places, not even at Feroe, under a latitude of 62°, does the mean of winter descend below zero; but on the other hand, the summers are not hot. At London, which is a little way in the interior, the difference between the mean of the two seasons is already 23° 2′. The south-west winds so frequent in England, carry warm vapours thither from the Atlantic, which hinder the radiation of the earth, and disengage, whilst they are precipitated to the earth, an enormous quantity of latent heat—hence the great mildness of the winters in Ireland, and on the west coast of England.

Let us now examine the climate of towns situate a little way in the interior of continents.

Places.	Winter mean.	Summer mean.	Difference.
Amsterdam,	36°.8	65°.8	29°.0
Maestricht,	37°.1	64°.6	27°.5
Brussels,	36°.6	66°.2	29°.6
The Hague,	38°.2	65°.5	27°.3
St. Malo,	42°.1	66°.0	23°.9
Dunkirk,	38°.1	63°.8	25°.7
Rochelle,	40°.5	66°.6	26°.1
Paris,	38°.45	64°.5	26°.05

We find in these places a mean winter temperature, not at all higher than that of the north of England; but the easterly winds of summer dissipate the clouds, an uninterrupted series of clear days succeeds, and the sun's rays warm the atmosphere and the ground. Thus the difference between the two seasons is in some places as great as 29° 6′.

If we penetrate further into the interior of continents, we shall find these differences still greater, as in the following table:—

Places.	Winter.	Summer.	Difference.
Tubingen,	31°.2	62°.7	31°.5
Augsburg,	29°.0	62°.2	33°.2
Berlin,	30°.5	62°.8	32°.3
Dresden,	30°.0	63°.0	33°.0
Munich,	32°.2	63°.5	29°.3
Prague,	31°.0	68°.0	37°.0
Vienna,	32°.3	68°.6	26°.3
St. Petersburg,	16°.0	60°.7	44°.7
Moscow,	13°.5	63°.6	50°.1
Kasan,	7°.3	63°.2	55°.9
Irkutzk,	0°.0	60°.8	60°.8

These figures show that the severity of winter and the heat of summer increase as we enter the European continent, and that the mean of winter sinks more than the mean of summer is raised. This law is a general one, for the same phenomena occur in Scandinavia and America.

Isothermal and Isocheimal Lines.—Conceive a line drawn through all the points on the earth, which have the same mean summer temperature. This will be an isothermal line. One which passes through all places having the same mean winter temperature, will be an isocheimal line. The curves described will be far from coinciding with the parallels which pass through all places equidistant from the equator. In the west of Europe, the isocheimal lines sink towards the equator; and in the east of Europe they rise towards the pole. The contrary takes place with respect to the isothermal lines. We may conceive the influence of these lines on vegetation and animal life. Thus, the elk, the largest of the stag tribe, is found in Sweden at the 65th parallel of latitude; in the interior of Siberia it is not found beyond the 55th. The Beech (Fagus sylvatica) advances in Norway as far as Bergen, 60° 24′; in Lithuania to the 55th parallel, but in the mountains of the Crimea, not beyond the 45th parallel.

Difference of Temperature at Places in the same Parallel.—As a general rule, the temperature gradually increases from the poles to the equator. According to Sir D. Brewster's formula, the distribution of heat varies from the equator to the poles in the meridian of the west of Europe as the cosine of the latitude. There is a number of exceptions to these rules, which seem to be owing to the following causes:—1. The winds; they cool the air of countries situate near the equator, and warm that of regions nearer the poles. 2. The vicinity of the ocean produces an analogous effect. For instance, the trade winds of the Atlantic cause a great current towards the west, which divides into two branches in the parallel of East Florida. One moves towards the south; the other, under the name of the Gulf Stream, rushes through the Caribbean Sea, where it has a temperature of 80°, into the Mexican Gulf, whence it makes its escape by the Gulf of Florida. It then moves along the east coast of North America, increasing in breadth, and diminishing in speed. In the latitude of Newfoundland, it turns to the east in order to pass southward along the African coast, the burning atmosphere of which it tempers; but it sends off a branch to the north, carrying with it, to the western coast of Scotland, the seeds of American plants, and the remains of vessels wrecked in the West Indian Archipelago. This current runs still further north, for seeds of the *mimosa scandeus* have been found at North Cape, and the high temperature of the surface of the sea between Spitzbergen and North Cape (37° Fahr.) cannot be otherwise explained. As far back as 1780, Blagden and Franklin recommended navigators to ascertain by the thermometer whether or no they were in the Gulf Stream; and between lat. 40° and 41°, Humboldt found its temperature 72° 5′, when it was no higher than 63° 5′ out of the current. Florida has a higher temperature than the Canaries, which are under the same parallel; but the Gulf Stream quitting America about lat. 50°, the temperature increases more rapidly on the east coast of the new continent, than on the western coast of Europe, as the following figures prove:—

Mean Temperature.	East Coast of America.	West Coast of Europe.
59°	38° 24′ lat.	41° 33′ lat.
50°	41° 30′ "	52° 3′ "
41°	44° 51′ "	63° 23′ "
32°	51° 57′ "	70° 56′ "

The combined influence of the Gulf Stream, and of the S.W. winds, soften the rigour of the climate of Norway to such an extent, that there is a difference of 10° between places on its coast, and places on the coast of America having the same latitude.

There is a counterpart current in the South Pacific, which brings the cold water of the South Seas along the western coast of South America, as far as the extreme north-westerly projection of that coast, where it turns westward, and is lost in the open ocean. At the point of deflection, the drifting waters is colder, by nearly 24° Fahr., than the ocean through which it flows.

Humboldt puts down the mean temperature of the equator at 81° 5′, Brewster at 82° 15′. In the interior of continents it is probably still higher.

If we draw lines through all points on the surface of the globe which have the same mean temperature, the curves produced are termed *isothermal.* The equator of temperature, *i. e.* the line of maximum heat, crosses the terrestrial equator in long. 102°, near Singapore; passes through Socotra and Konka in Africa, both north of parallel 12°; dips to within 2° of the equator, in W. long. 18°; rises again till it passes north of the South American continent, in N. lat. 12°; and sinking rapidly to within 3° of the equator, it crosses it in W. long. 150°; and descending 7° south of the equator, it gradually rises to it again at Singapore.

The isothermal line of 77° begins on the west coast of America (lat. 16° 50′), a little to the north of Acapulco; passes by Vera Cruz to the north of Havannah; sinks towards the mouth of the Senegal, on the African coast; crosses the northern extremities of the Red Sea and the Persian Gulf; and terminates to the north of the island of Lacon, in N. lat. 17°.

The isothermal line of 68° commences in California, about 28° N. lat., and proceeds nearly parallelwise to the preceding; passes between Madeira and Teneriffe, a little to the north of Algiers, between Grand Cairo and the Isle of Crete, and terminates in China, near Nankin.

The isothermal line of 59° cuts the west coast of America, near San Francisco (lat. 37° 48′); passes into the state of Delaware, between 37° and 38° lat.; then rising towards the north, reaches the northern frontier of Portugal; passes a little to the north of Rome; sinks towards northern Turkey; and terminates in southern Japan, about 32° 45′ lat.

The isothermal of 50° starts at the mouth of the river Columbia, on the west coast of America; it sinks immediately in the Ohio; crosses to north of the state of New York; then rises suddenly, and almost reaches London; enters France near Dunkirk; then sinks again further east; passes near Prague; pursues the north shore of the Black Sea; and probably terminates at Japanese, the island of Nipon.

The isothermal of 41° cuts the west coast of America about the 58th parallel; crosses Michigan Lake and the state of Maine; passes south of Newfoundland to the north of the Feroe Islands; enters the Norwegian coast at Drontheim; sinks southward, on the other side of the Scandinavian Alps; passes north of Stockholm and south of Moscow, to the Asiatic coast, which it enters in the same parallel with the Kurile chain.

The isothermal line of 32° is found in the lat. of Labrador; then it enters the southern point of Iceland; rises to the North Cape; sinks parallel to the Saponian chain; passes to the north of the Gulf of Bothnia; then to the north of Kasan; and enters the east coast of Kamtschatka, near the 56th parallel.

These lines are the only ones which make the circuit of the globe. Those below zero extend from N. America to the north of Siberia, and return upon themselves.

The temperature of the north pole of the globe is probably from 12° to 15° Fahr.

The poles of cold do not coincide with the terrestrial poles; but they are nearly coincident with the magnetic poles. There are two such poles in the northern hemisphere. One is situate in 80° lat. and 100° W. long.: this has a temperature of — 3° 5′. The other is situate in 80° lat. and 95° E. long., and has a temperature of 1°. About these points the isothermal lines form a system of spherical lemniscates until they cease to communicate, and they then encircle the poles like rings.

The temperature of the southern hemisphere is much less known. One fact, however, seems placed beyond a doubt—viz., that in latitude for latitude the climate is much colder than in the northern hemisphere. One consequence of this is, that the extent of ice around the south pole is much greater than that around the opposite pole. The sun remaining about six days longer in the northern hemisphere, it is evident that it receives more heat; and moreover, there is no great equatorial current setting towards the south pole.

Temperature of the Ground.—If a series of thermometers, buried at different depths in the ground, are daily consulted, we shall find that those which are not deeper than 8 inches will show a daily variation in the temperature; from that depth to a depth of 24 inches, the daily mean only is indicated; deeper than that, down to a depth of about 10½ feet, the monthly mean only is shown; and, at a depth of about 35 feet, we have a temperature varying little through the whole year. The motion of the mercury in such thermometers is not cotemporaneous with those exposed to the air. The more deeply buried they are, the longer are their maxima after those of the atmosphere, on account of the time which the atmospheric heat takes to reach their bulbs. In countries where the annual variation is not great, as in tropical America, a thermometer placed at a depth of 1½ to 2 feet in the ground will indicate a constant temperature.

By means of the temperatures of the ground, M. Boussingault has determined the mean temperature of 128 points situate between 11° N. lat. and 5° S. lat. Assuming 35° Fahr. as the mean temperature of the limit of perpetual snow, at a height of 15,750 feet above the sea, it would seem that there is a decrease of a degree of Fahr. for every 320 feet.

Temperature of Springs.—Springs are supported by rain water, filtrating slowly through strata of the earth, until they meet with an impervious bed. Their temperature depends, like the height of the line of perpetual snow, on numerous and highly complex causes. If the filtrated water accumulates in a reservoir, placed sufficiently deep to be uninfluenced by daily and monthly variations, they will have, on issuing into the atmosphere, a temperature approaching to that of the year. The temperature will be below the mean temperature of the place where the spring appears, if it comes from a high level; above, if from a level of great depth. In western Europe the temperature of springs is nearly equal to the annual mean. In the centre of the continent, north of the Alps, their temperature is higher. In Italy, and between the tropics, it is lower. These differences are in accordance with the relative quantities of rain which fall in each season. In England, where it rains as much in winter as in summer, the temperature of the springs is that of the annual mean. In Germany, where it rains more in summer, it is higher. In Italy, and between the tropics, where it only rains in the cold season, it is below. Covered wells will also give an approximation to the annual mean, if their total depth is between 50 and 90 feet, and that of the water between 16 and 32 feet.

Thermal Springs.—Every spring, the temperature of which is several degrees above the mean of the year, may be considered as a thermal spring, since its temperature is not dependent solely upon the atmosphere. They are found both in plains and on high mountains; but it is in grand chains where they are most numerous. Most of them have a temperature between 70° and 100°; a few only are as high as 120° or 140°. The following list gives the temperature of some of the best known thermal springs:—

	Degrees.
Courmayeur, Piedmont,	94
St. Gervais, Savoy,	97
Bariges, France,	120
Leuk, Switzerland,	126
Cauterets, France,	131
Bagnères, France,	138
Aix-la-Chapelle, Prussia,	142½
Borset, Prussia,	158
Carlsbad, Bohemia,	165
Trinchera, America,	205
Reckum, Iceland,	212
Geyser, Iceland,	255

Temperature of the Ocean.—Its surface has usually the same temperature as the air in contact with it, and that temperature varies with the seasons. Below a certain level, which varies with the latitude, the depths of the ocean have one invariable temperature throughout the globe, and that a very low one—probably from 36° to 40°. At the equator this temperature is reached at about a depth of 7,200 feet, and the isothermal line gradually approaches the surface in proceeding towards the poles. In the southern hemisphere it reaches the surface, according to Sir James Ross, at the parallel of 56° 26′, and here the sea is of the same temperature at all depths. From this point the line again sinks; but now the colder water is above it, and at the parallel of 70° it is 4,500 feet from the surface. By this line the ocean is divided into three regions—two polar basins, and an equatorial zone. It would seem, from the more recent observations, that the internal heat of the earth exercises no influence upon the mean temperature of the ocean.

We must distinguish, says Humboldt, four different phenomena with respect to the temperature of the ocean:—1. The surface temperature in different latitudes. 2. The decrease of temperature in the lower strata. 3. The effect of waves on the surface temperature. 4. The temperature of currents. The region of warmest water is between 5° 45′ N. and 6° 15′ S. lat.; and 82° to 84° may here be considered the maximum temperature. In the parallel of warmest water, the surface is from 3° to 5° warmer than that of the superincumbent air. The great oceans frequently retain nearly the same temperature over a vast extent.

Decrease of Temperature with Height.—The higher we climb above the mean level of the globe, the more the temperature decreases; and this decrease varies with each hour of the day, and each season of the year. It would appear that this decrease is more rapid in the day than in the night—that it reaches its maximum about 5 p.m., and that about sunrise it is least. It is less rapid in winter than in summer; and it seems that the inequality between those seasons in point of temperature becomes less and less as we ascend. In France there is a mean fall of 1° Fahr. for every 290 feet of height.

The size of mountains, and the steepness of their slopes, influence the rate of decrease. It decreases more slowly above plateaux rising in succession, than along the escarped flanks of an isolated peak. Thus, the Andes, as far as they are inhabited, form immense plateaux, and from the sea to the village of Calpi the decrease is 1° Fahr. for 470 feet; but from this point, it is 1° Fahr. for 290 feet along the escarped flanks of Chimborazo. This law has been confirmed by observations in Mexico and at the Himalayas. Humboldt calculates that the mean decrease between the tropics is 1° Fahr. for 306 feet.

It is to be remarked, that as we ascend higher, the smaller become the differences of temperature observed at a given place, and the more the climate approaches to a marine climate. But it is always necessary to mount higher than the highest mountains to reach a uniform temperature, for the surface of the snow melts even on the summit of the loftiest Alp.

This decrease of temperature is to be attributed to the greater rarefaction of the air in the higher regions of the atmosphere, and consequently to the fact, that less heat is imparted to the thermometer by conduction, whilst the radiation of heat into free space is more active.

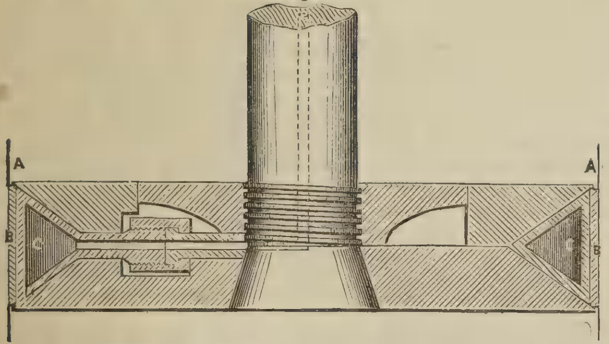
Limit of Perpetual Snow.—It is rarely that any rain falls on the elevated mountains even in summer. The rain of the plains there descends in the shape of snow. As far as a certain height, it is melted away by the heats of summer; but above, the snow lies all the year round. The line dividing the snow which is so removed from that which always remains, is termed the line of perpetual snow. The height of this line depends, in a great measure, on the latitude. When the mean temperature, at the level of the sea, is below the freezing point, there, of course, the snow line descends to the sea, and it rises gradually until it reaches the equator. The regularity of the ascent of the line is, however, broken by a variety of local circumstances, such as the heat and duration of the summer, the quantity of snow which falls in winter, the configuration of mountain chains, and the direction of high winds. The effect of such circumstances will be seen in the following table. On the southern face of the Himalaya, in lat. 31°, the height of the snow line is about 13,000 feet; whilst on the northern face of the same range, its height is as much as 16,600 feet, in consequence of the radiation from the high lands of Thibet, which have an altitude of between eleven and twelve thousand feet. Again, in part of the Andes chain, 18° S. lat., the snow line is many hundred feet higher than at the equator:—

Country.	Latitude.	Height of Snow Line.
South America,	0° 0′	15,700
Bolivia,	16° to 18° S.	17,000
Mexico,	19° N.	15,000
Himalaya—south declivity,	30° N.	13,000
" north declivity,	31° N.	16,600
Central Chili,	33° S.	14,000 to 15,000
Central Asia,	37° 27′ N.	17,000
Ararat,	39° 30′ N.	14,100
Chiloe,	41° to 43° S.	6,000
Pyrenees (mean),	42° 45′ N.	8,900
Caucasus,	43° N.	10,900
Alps,	45° 30′ N.	8,600
Terra del Fuego,	54° S.	3,500 to 4,000
Norway,	60° N.	5,400
Norway,	67° 70′	3,500 to 4,000
Norway,	71° 10′	2,300
Spitzbergen,	79° 30′	0

MOAT'S IMPROVED PISTON AND STUFFING-BOX PACKING.

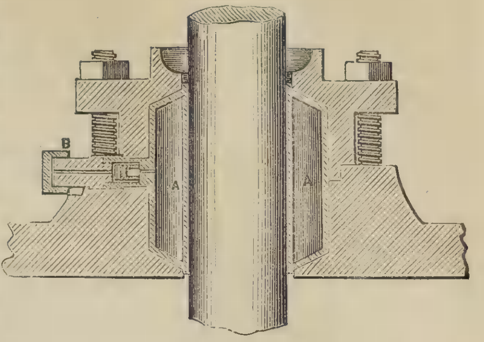
A peculiar novelty in steam-tight packings has been recently introduced, under the patent of Mr. W. C. Moat, of Upper Berkeley Street, London, in which compressed air is ingeniously adapted to give the required elastic contact with the rubbing surfaces. The application of the contrivance to pistons is explained in fig. 1, which is a vertical section of a piston as fitted in a cylinder, the bore of which agrees with the lines, A A. The working surface of the piston is formed by the ring, B B, of cast-iron, turned to fit the cylinder, and held in its place by recesses turned in the peripheries of the two halves of the piston. Immediately behind this is a hollow ring, C C, of some soft or yielding material, as lead or vulcanized india-rubber. In its original state, this ring is of cylindrical section; but, when pressed into its place, it takes a triangular shape from the internal figure of the recess in the piston; and, when expanded by an internal air pressure, it exerts a firm elastic force upon the inner side of the piston-ring, B B, so as to keep it in close contact with the cylinder. The air is supplied to the ring by a bore down the centre of the piston-rod, which bore meets another at right angles to it, near the lower end of the rod, and a pipe leads from this, by a union-joint, to the interior of the ring. The patentee specifies different methods of charging the ring with air. The bore at the top of the piston-rod terminates in a small valve-box, to which one end of a flexible coil of pipe may be attached, whilst the opposite end is connected with a small force-pump. The amount of pressure is regulated by referring to a guage; and when correctly set, the coil of pipe is removed, and the valve-cap is screwed on to retain the pressure. In place of forcing the air down the piston-rod, it may be introduced by a pipe passed down through the cylinder alongside the piston-rod, to the body of the piston; or it may be at once injected by a syringe passed through a door in the cylinder cover. Fig. 2, explains the adaptation of the same principle to stuffing-boxes. Here, A A is the hollow ring, supplied with compressed air by the passage, B, the elastic pressure being given inwards upon the piston-rod.

Fig. 1.



If some more convenient mode could be devised for forcing the air into into the ring, Mr. Moat's invention would be a very acceptable improvement upon the present system of dead-spring packing; but the bore down the piston-rod, and the several valves and connections, are all inconvenient and costly additions to the engine. It is true, that when once inflated, there is little chance of a loss of elasticity in working; but wear must be provided for, and hence arises the necessity for frequent renewals of the elastic power.

Fig. 2.



LAW OF PATENTS.—REPORT OF THE GOVERNMENT COMMITTEE.

The report of the committee appointed by the Lords Commissioners of the Treasury to inquire into the circumstances connected with the offices of the clerks of the Signet, and of the Lord Privy Seal, has been recently issued. It is a document of considerable importance to a large proportion of our readers, as the inquiry of the committee has been directed not only to the practice of those offices, but in fact to the whole process of passing patents. The evidence upon which the report is based, consists of very long examinations of the clerk of the Patents, to the attorney and solicitor-general; the record-keeper of the Signet Office; the junior clerk in the Privy Seal Office; the clerk of the Patents; the chief clerk in the Great Seal Patent Office; the clerk of Inventions to the attorney and solicitor-general; Mr. Webster, a gentleman at the bar, who has been much engaged in patent matters, and who is also well known as the author of several valuable publications on the law relating to patents; a patentee of considerable experience; and six patent agents. The committee preface their report by observing, that they have had before them persons whose interests are variously affected by the mode of passing patents, but we cannot help regretting that they had but one gentleman before them directly affected as a patentee. To enable our readers readily to understand the several amendments recommended by the committee for adoption, we are compelled to give a summary of the present practice of passing patents.

A petition to the Queen is, in the first place, left at the office of the secretary of state for the home department. This petition is referred by the secretary of state to the attorney or solicitor-general, to consider and report thereon, in order that the crown may be advised regarding the legality of the grant solicited, and the expediency of granting it. If the title of the invention appears to relate to an invention which comes within the general description contained in any of the caveats lodged in the attorney and solicitor-general's offices, the clerk to the attorney or solicitor-general, to whom the petition has been referred, immediately sends out to the persons having entered such caveats, notices of the application, to give them an opportunity of opposing the petitioner, if they are desirous of doing so. They are allowed seven days for this purpose. If no opposition is entered within that time, the matter proceeds as of course; but if an opposition is entered, the whole proceedings are stayed until it is disposed of, for which purpose the petitioner must obtain a summons for a hearing before the attorney or solicitor-general, a copy of which must be served on the opposing party. The attorney or solicitor-general then hears the parties separately, and if he is of opinion the petition should be granted, he immediately makes his report to that effect, which report is left at the Home Office in order to obtain the Queen's warrant. If the opposition is successful, the attorney or solicitor-general does not make any report, and the matter there drops. The Queen's warrant is an authority from the crown to the attorney or solicitor-general to prepare the bill for the intended patent. When completed, it is left at the Patent Bill Office, where all bills for patents to pass the great seal are prepared. The Patent Bill Office is an office of the attorney and solicitor-general. A petitioner may be again opposed at this stage of the proceedings; the opposition is disposed of in a similar manner to that above described, with this exception, that the opposing party must, on entering his opposition, deposit £30 as security for the costs. If there is no opposition, the bill is passed as of course, and submitted to the Queen for signature. When so signed, it is called the Queen's bill, and is passed to the Signet Office, where it is filed as the warrant to the clerk of the Signet, for preparing and issuing the signet bill to the Lord Privy Seal. This bill is filed at the Privy Seal Office, as the Lord Privy Seal's warrant for his proceedings. There is a public seal only once a week at the Privy Seal Office, and if a patentee is desirous to have the bill sealed at any other time, he is compelled to pay extra fees for that purpose. When the Privy Seal Bill is obtained, it is left at the Patent Office of the Great Seal, which is an office of the Lord Chancellor, the keeper of the great seal. An opposition to the grant may be again entered here: it is in the first place referred to the attorney or solicitor-general, but if the parties are dissatisfied with his report, it is heard and discussed by the Lord Chancellor in person. An opposition at this stage of the proceedings is attended with very great expense, and is now very rare. The patent invariably contains a clause, that the patentee shall, within a given time from the date of his patent, fully describe his invention by an instrument in writing, under his hand and seal, termed a specification, to be enrolled in Chancery, in default of which the patent is void. Prior to the 1st of January, 1849, there were three offices in which the specifications might be enrolled, but by an act passed last session, all specifications must be enrolled in the Chancery Enrolment Office only.

It will be seen, from the foregoing summary, that the proceedings necessary to obtain a grant of letters-patent for England are extremely complicated and cumbersome; and the committee report, that the number of successive stages through which a patent must pass before its final completion, is productive of great trouble, delay, and expense to the party seeking the grant, without any corresponding benefit to the public.

The committee also report, that as the fullest opportunity ought to be afforded to all persons whose interests may be affected by the grant of an exclusive privilege to manufacture a particular article, to show that good grounds exist why that privilege should not be granted, and that, as the object of making the grant is not merely to secure to the inventor the fair reward of his ingenuity, but also to benefit the public by encouraging such inventions, it is essential that the crown should have some tribunal to refer to for advice, before making such grants. It does not appear to them that any better course can be devised than a reference to the attorney or solicitor-general, to inquire into the merits of the circumstances set forth in the petition, and report thereon to the crown. They remark, that the inquiry seems for the most part to involve considerations rather of a legal than a scientific nature; but that, if cases should arise where a more than ordinary knowledge of scientific subjects should be requisite to enable a just decision as to the matter in dispute to be arrived at, then the attorney and solicitor-general might use the power which they now have, of calling in some man of practical science to assist them in such determination. As ample opportunity is afforded at this stage of the proceedings for an opposition, they think that the power to oppose at the Patent Bill Office might safely be disposed of; and recommend, in case this plan should be adopted, that a public notice, by advertisement in the Gazette, or otherwise, should be given, that a patent for a particular object has been applied for, not naming the applicant, or giving more than a very general description of the object of the invention; and that a sufficient number of days should be allowed, from the date of the advertisement, before proceeding with the petition, in order that a fair opportunity may be afforded to parties desirous of opposing the grant solicited.

They also recommend that an outline description, such as is now required to be deposited with the attorney or solicitor-general in cases of opposed patents, should be required to be lodged, under seal, with every petition, on its first presentation at the Home Office. This should not be required to enter into the details of the invention, but should be considered binding as to the principles of it. With these provisos, they are of opinion that a patent might be dated from the day on which the petition is presented.

They further suggest for consideration, whether, after the report of the attorney or solicitor-general recommending the grant, a Queen's bill, carrying that recommendation into effect, might not be prepared at the Home Office, and submitted by the secretary of state for her Majesty's signature, thus doing away with the Queen's warrant and the patent bill; and that the Queen's bill, when signed, should be at once passed to the Lord Privy Seal, without the intervention of the Signet Office; that the privy seal should be affixed upon the authority of an instruction to that effect from the secretary of state; and that the transcripts now prepared in the Patent Bill Office, and forming the privy seal and signet bills, should be dispensed with. They also recommend that there should be two public seal days at the Privy Seal Office in each week, instead of one only, as at present. In case these recommendations of the committee should be adopted, the fees on passing the patent up to the great seal would necessarily require revision. As the confining the opposition before the attorney and solicitor-general to one stage only, would, in the opinion of the committee, render necessary a more rigid examination at that stage than is at present required, they consider those officers would be entitled to a higher fee for the single hearing and report than is at present required, and therefore recommend one fee of ten guineas to be allowed for the hearing and report together, including clerk's fees, instead of the fees of £4 4s. for the report, and £3 5s. for the hearing, at present allowed. They also recommend, in lieu of the successive payments of fees and stamp duties at the several offices now paid, that a stamp of one uniform value, without reference to the number of names included in the grant, should be affixed to the Queen's bill, in the department in which it is prepared; and that, if it should be determined to extend the power of granting patents under the great seal of the United Kingdom to Scotland and Ireland, that the amount of stamp duty should be £50; but that, if thought inexpedient to debar inventors from taking out patents for England alone, then that the stamp duty on patents for England, with the channel islands and colonies, should be £30, with an addition of £20 for Scotland and Ireland, or £10 for either Scotland or Ireland separately.

The attention of the committee was also directed to the specifications and their enrolment; and for the purpose of making them more available to the public than at present, they recommend that proper indexes should be made of them, and that, instead of being copied on rolls in an engrossing hand, as at present, they should be entered in a book form, in the common hand.

By the terms of the acts of union of the United Kingdom, the Lord Chancellor is precluded from granting a patent which can extend to Scotland and Ireland, and an inventor, desirous of securing the full benefit of his invention for the whole of the United Kingdom, is therefore compelled to go through three distinct processes, thereby very considerably increasing the trouble, delay, and expense of his patent. The committee have directed their attention to this point, and after setting out the routine to be observed in the procuration of patents for Scotland and Ireland, they suggest that all patents should be granted as of course for the United Kingdom of Great Britain and Ireland, and that the proceedings for the purpose should take place in England only, but that the specification should be enrolled in each of the three capitals. As cases, however, might occur, in which it might be advisable to have the opinion of the crown lawyers in Ireland or Scotland, previously to her Majesty being advised to grant the letters-patent, the committee suggest, therefore, that, if it should be determined to give the power of granting patents under the great seal of the United Kingdom, which should have effect in the three kingdoms equally, a discretionary power should be given to the secretary of state, enabling him, should he see fit so to do, to refer the petition either to the attorney or solicitor-general for England, the attorney-general for Ireland, or the lord-advocate of Scotland.

If the several recommendations of the committee be adopted, the retention of the Signet Office as a distinct branch of the department of the secretary of state, would become unnecessary, and the committee therefore recommend that that office should be abolished.

The minute by which this committee was appointed, bears date the 23d June, 1848, and the report itself is dated the 30th January, 1849, whilst the report was not issued to the public until the last week in July, a delay of six months having occurred between the date of the report and its publication, of which we think the public have good right to complain in a matter so important.

We may conclude this article with some remarks which have originated in the consideration of this report, in connection with the accompanying evidence.

There are few persons interested in patents, and acquainted with the present tedious and expensive process of procuring them, who will not arrive at the same general conclusion as that expressed in the report, namely, that "the number of successive stages through which a patent for a new invention must pass before its final completion, is productive of great trouble, delay, and expense to the party seeking the grant, without any corresponding benefit to the public;" but it has often been remarked, that it is much easier to find fault with an existing system than to propose an efficient remedy for it. The several gentlemen whose evidence we have before us, all agree in condemning the present system; but we do not collect that any of them are enabled to point out any regular system likely to meet the want of patentees, on the one hand, and, on the other, to satisfy the law officers of the crown.

We ourselves cannot agree in a remark contained in the report, that the inquiry on an opposition before the attorney or solicitor-general involves considerations rather of a legal than of a scientific nature. The object of this inquiry is, most usually, whether the invention for which the petitioner is applying for letters-patent, is identical with that of the opposing party; and it must, we think, be allowed that this may, and, in fact, very frequently does, involve questions of very minute scientific or mechanical detail, of which the attorney or solicitor-general can scarcely be considered competent judges, the more especially as those offices are held very frequently for a very limited term; and by the time they have acquired some knowledge of the general principles upon which those questions must be decided, they are removed from their position as referees, which are again filled by gentlemen who must commence the same routine. To remedy this, which is a very important matter, one of the witnesses suggested that the attorney and solicitor-general might have a permanent assessor (not removable as those officers themselves are in every change of ministry), who should be conversant as well with the law of patents as with the principles of mechanics, &c. This would be an improvement upon the present system.

The recommendation of the committee, that in every case, whether opposed or not, the petitioner should be compelled to deposit in the attorney or solicitor-general's chambers, under seal, an outline description of his invention, is one that would much conduce to the benefit of inventors. It is well known that patents are frequently obtained without the party obtaining them having at the time any invention of the kind, but merely trusting to something sufficiently within his title arising before the time of his specification becomes due, which he may include in his specification, and reap the benefit of. If the plan recommended by the committee were adopted, there would be much more safety to the original inventor, who may, under the present system, be very easily defrauded of all benefit from his discovery.

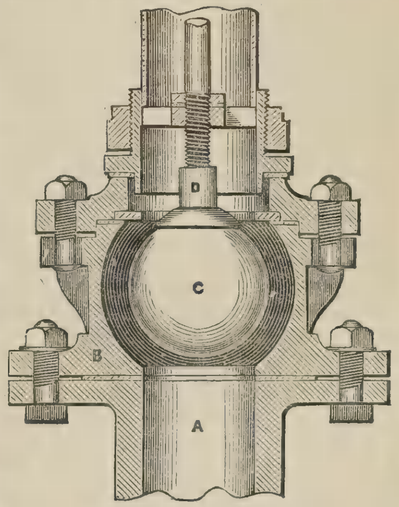
Another recommendation of the committee we cannot so cordially agree in; it is, that if the confining the opposition before the attorney or solicitor-general to one stage only be adopted, it would render a more complete investigation necessary, and thus throw increased responsibility upon these officers. They therefore consider that their fees should be of a higher amount than at present, and recommend that one fee of ten guineas should be allowed to the attorney and solicitor-general for the hearing and report together, including their clerks' fees, instead of the separate fees of £3 3s. for the hearing, and £4 4s. for the report, which they at present receive. As this is all that is said upon the subject, it does not appear clear to us whether the committee were of opinion that this fee of ten guineas should be paid in all cases, whether opposed or unopposed, or whether it should only be in cases of opposed applications. From the wording of the sentence, it would appear that they contemplated an opposition in every case, whereas about one in four only are opposed. They also appear to have overlooked the fact, that in the case of an opposition, the attorney or solicitor-general is paid by both parties; and that, in fact, his fees at present, in an opposed case, amount to ten guineas, which we submit is a very handsome remuneration for the amount of trouble. The recommendation of the committee, that the fees should be reduced in the case of a patent for the United Kingdom to £50, instead of about £300 as at present—is, we think, dangerous, as being likely to encumber manufacturers by the number of patents so much, that it would be scarcely possible for them to make the slightest modification in their machinery or system, without interfering with some patent right.

We are glad to observe that the committee extended their inquiries into the present practice regarding the enrolment of specifications. Prior to the 1st of January, 1849, there were three offices in which specifications might be enrolled at the option of the patentee—viz. the Chancery Enrolment Office, the Petty Bag Office, and the Rolls Chapel. By an act of parliament, passed in 1848, however, all specifications are to be enrolled in the Chancery Enrolment Office. This act does not provide that all the specifications up to that time should be removed from the other two offices to the Enrolment Office, and it is therefore necessary, in order to inspect any particular specification of an existing patent granted prior to 1849, to search through the three offices above-mentioned. This is, of course, a work of much time and labour, and of considerable expense. The fee for the search at such office is 1s., in addition to which, at the Petty Bag Office, 2s. 6d. more is charged for the perusal. At the Chancery Enrolment and Petty Bag Offices, no extracts are allowed to be made from the originals, which is a great hardship to patentees, as it compels them, in order to have their own specifications properly drawn, to go to a great expense in procuring office copies of specifications of other patents for inventions of a similar nature. At the Rolls Chapel, it is, however, different—there, extracts are allowed to be made in pencil, as well as tracings of the drawings. This privilege is, unfortunately, of little benefit to the public, as very few specifications have been enrolled in this office. Specifications are at present written in the engrossing hand, on rolls of parchment, which is a very inconvenient method, as that hand is not easily made out by any one not accustomed to it. The recommendation of the committee, that the specifications should be entered in a book form in the common round hand, and that proper indexes should be made of them, would, to some extent, remedy the evil. Some other remarks upon this highly important subject have occurred to us, which, however, want of space compels us at present to postpone; we hope to be able to recur to the subject in an early number, and in the meantime, it will give us great pleasure to receive communications upon the subject, from such of our readers as may be inclined to communicate their impressions.

We perceive that Mr. Milner Gibson has entered a notice for an inquiry into the existing law on patent privileges, and registration of designs, for next session, and we trust that a bill will then be introduced into the House, to give inventors that increase of protection to which they are entitled, and that the recommendation of the committee may have that amount of consideration from the legislature, which the importance of the subject demands.

BATEMAN AND CHRIMES' FIRE-COCK.

An important improvement has recently been made upon the ingenious fire-cock of Mr. Chrimes, previously figured and described by us,* by combining with it the buoyant ball-valve, patented by Mr. J. F. Bateman, the eminent hydraulic engineer of Manchester, in conjunction with Mr. Moore. In the first named arrangement, the water way is opened and closed by a vertical spindle passing down the centre of the standpipe on the top of the valve-chest, and through a central fixed guide-nut in the pipe, to the top of the spindle of an inverted lift-valve, which is pressed upwards to its face by the water column. The screwing down of the spindle, causes a downward pressure upon the valve against the water, so as to open the passage, whilst, upon the return of the spindle, the water pressure again closes it. In Mr. Bateman's plan, instead of the cylindrical valve-chest, with a plain metal valve, a chest of a spherical internal section, containing a ball of lighter specific gravity than water, is used, and this, as before, forms the connecting link between the main, and the standpipe. The valve is clearly shown in the engraving, which represents it in vertical section; A, is the end of the branch from the main, and upon this, the valve-chest, B, having in its interior the spherical ball, C, of India-rubber or gutta-percha, is bolted. The top of the valve-chest is formed by a short cap-piece, recessed to receive a disc, to form the face for the ball valve, whilst its upper opening receives the lower end of the stand-pipe, the joint being formed by a ring of leather or other soft material. The end of the valve spindle is fitted with a small-cap piece which comes down upon the top of the ball, when the valve is to be opened. Our engraving shows the valve in this condition, the water having a clear way all round the ball. This is certainly a great improvement upon the original valve, as it is much simpler in construction, and leakage is impossible. A complete stand-pipe, with valves of both kinds, may be seen by those who are interested in matters of this kind, at our office.



WAKLEY'S SONOMETER.

Mr. Thomas Wakley, the surgeon of the Royal Free Hospital, London, has recently introduced a most important instrument for the use of parties under treatment for deafness. It is intended as a test for the actual condition of the state of hearing of the patient during the various stages of the complaint, by questioning the power of the ear through the medium of a graduated scale of sounds, and for this reason it is aptly

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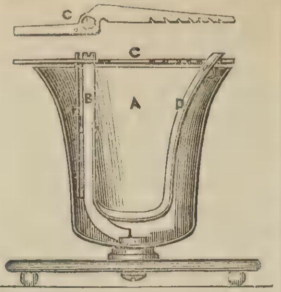
* Page 209, Vol. I.



named the sonometer. Our engraving exhibits a vertical section of the instrument, on a small scale, as complete for use. It consists essentially of an inverted bell, A, screwed down to a light stand, and from the bottom of its interior a curved pillar, B, springs upwards, and carries on its upper end a serrated lever bar, C, a plan of which is given detached, immediately over the mouth of the bell. This lever is arranged to oscillate horizontally upon a pin on the top of the pillar, C, being retained in its place by a delicate spring, carried by the pillar, and pressing on its shorter end. The same pillar also carries a curved spring, D, which has a small hammer on its top, near the rim of the bell. It is fitted for setting into any of the notches or serrations of the lever, C; and accordingly, as it is set nearer to or further from its extremity, the blows of the hammer upon the bell will be fainter or more distinct.

The plain end of the lever, C, answers as the disengaging handle; for, by pressing it a little on one side, the spring, D, leaves the notch in which it is placed, and the hammer strikes a blow upon the bell, producing a tone loud or dull, according to the notch used. Every one who has considered the peculiarities of the affliction of deafness, will at once see the value of this simple instrument; for, by means of the regulating arrangement, the sound produced may be varied from the tick of a watch up to the sharp, clear tone of a hand-bell, and thus, by trying several tones, the exact state of the hearing may be discovered at once.

PHENOMENA OF STELLAR ASTRONOMY.

The arbitrary division of the stars into constellations is only to be considered as a means of referring the more readily to the remarkable ones. This is effected by adding to the name of the constellation a letter from the Greek alphabet, as Alpha Leonis, Beta Scorpionis, the name of the constellation being usually in Latin. Most of the constellations derive their names from very ancient times. The simplest method of acquiring a knowledge of them is to use a celestial globe, which can be easily compared with the heavens at the different seasons of the year. The following directions, however, will enable any one to discover the principal stars without other assistance. Every one is acquainted with the constellation called the *Great Bear*. It consists of seven bright stars, arranged somewhat in a sickle form, only that the blade of the instrument in this case is square and not curved. Now, the *pole star* (so called because it is situate very near the north pole of the axis round which the earth performs its diurnal motion) lies upon a line drawn through the two outer stars of the Great Bear, which stars obtain, for this reason, the name of the Pointers.

Cassiopeia is directly opposite to the Great Bear, with the pole star between them. It is formed of six or seven stars, in the shape of a Y, or a chair turned upside down.

The *Little Bear* has pretty much the same figure as the Great Bear, the position of the stars being reversed. The pole star, which is a star of the third magnitude, is at the end of the tail.

Arcturus is the principal star of *Bootes*. It is of the first magnitude, and is pointed out by the tail of the Great Bear, from which it is only 31° distant.

When the Great Bear is in the meridian, two stars of the first magnitude are visible—the *Harp Star* and the *Goat Star*—one in the east, the other in the west, right and left of the pole star, the latter being in the east if the Great Bear is above the pole star.

The *Dragon* is a very large constellation, which is seen between the two Bears, the tail of the Dragon being between the pole star and the square of the Great Bear. It is composed of a great number of small stars, which are twisted about like a serpent; the four stars of the head form a lozenge, placed between the Lyra and the Little Bear.

Amongst the constellations of winter the most beautiful of all is *Orion*. The three stars which form the belt, point to Sirius, the Dog Star—the brightest star in the whole heaven—on one side; and on the other, to the cluster of the Pleiades, of which the largest star is Alcyone. Immediately below the belt is Rigel, in the foot of Orion. Above the belt are Bellatrix in the right shoulder, and Betelgueze in the left shoulder.

Aldebaran, which forms the eye of the *Bull*, is a star of the first magnitude, situate between the Pleiades and Orion.

Procyon, in the *Little Dog*, is a star of the first magnitude, situate to the north of Sirius, and more to the east than Orion. With Sirius and Orion's belt it forms almost an equilateral triangle. Procyon is half-way between Sirius, and Castor and Pollux, the principal stars of the constellation Gemini, the Twins. A line drawn diagonally through the square of the Great Bear will arrive at the same constellation.

South of Orion's belt is a cluster of stars forming the *Sword*, or the nebula of Orion. A line drawn from these stars through the middle of the belt will pass the southern horn of the Bull to the Goat Star, Capella.

Perseus is between Cassiopeia and the Goat. His girdle is formed by three stars, through which passes a line drawn from the pole star to the Pleiades. A line drawn to the south-west, perpendicularly to the girdle, and a line brought from Orion's belt through Aldebaran, will meet at a star in the head of Medusa, called Algol, which is continually changing colour.

The *Lion* may be discovered by the two pointers of the Great Bear, which indicate the constellation in the direction opposite to the pole star, and at a distance of 45°. The Lion is a large trapezium, with a star of the first magnitude, called Regulus, or the Lion's Heart.

The *Swan* is a remarkable constellation in the Milky Way, shaped like a large cross.

The square of *Pegasus* is formed by four stars of the second magnitude. The most northerly of the four, forms the head of Andromeda. A line drawn from the pointers of the Great Bear through the pole star, if prolonged, will pass through the middle of the square of Pegasus. One of the diagonals is directed to the north-west, towards a star called Deneb, in the tail of the Swan.

The constellations which are visible in the evenings of summer have not so marked a character as those of winter; but they are to be recognised by means of the preceding. When the middle of the tail of the Great Bear is in the meridian, above the pole star, and at the highest point it ever reaches in the sky, which occurs about 9 o'clock p.m., at the end of May, we see more to the south the ear of the *Virgin* (Spica Virginis), in the meridian. It is a star of the first magnitude; and a little below to the right is seen a trapezium, formed by the four principal stars of the Crow.

The *Harp Star* (Vega) is one of the first magnitude, which forms nearly a right-angled triangle with Arcturus and the pole star, the right angle being towards the east.

The *Eagle* contains a beautiful star of the second magnitude, which is situate to the south of the Harp and the Swan. It is easily made out, because it is between two stars of the third magnitude, the three being in a straight line.

The line, or great circle, which passes through Regulus and the Ear of the Virgin, reaches, further to the east, the remarkable constellation of the *Scorpion*, composed of four stars (one of the second magnitude), and of another star of the first magnitude, a little more to the east, named Antares.

A line drawn from Antares to the pole star first crosses the constellation Sepentarius, and afterwards that of Hercules, which is a four-sided constellation, composed of four stars of the third magnitude.

The stars are usually classed after their apparent lustre or magnitude. No more than six (or, under particularly favourable circumstances, seven) magnitudes can be seen with the naked eye; but with the aid of the telescope, we can see much farther. There are reckoned 20 stars of the first magnitude, 70 of the second, 220 of the third, 500 of the fourth, 690 of the fifth, and 1,500 of the sixth. Whatever the apparent magnitudes of the stars may be, it is only by the intensity of their light, and not by any measurable diameter, that they are distinguished from one another. The more perfect the telescope, the more do the stars seem to contract into minute shining points.

The rudeness of the ordinary mode of expressing the magnitudes of the stars induced Sir John Herschel to propose a new method of obtaining a numerical expression of them, viz., by determining the comparative intensities of their light. He would take Alpha Centauri as the normal star of the first magnitude (its light being represented by the expression 1·040); Beta Crucis, of the second magnitude, the numerical expression being 0·255; Kappa Orionis, of the third magnitude (expression 0·120); Nu Hydræ, of the fourth magnitude; and 8 Volantes of the fifth magnitude. By means of a peculiar apparatus, he determined photometrically the light of several stars, of which the most conspicuous are—Sirius, 4·052; Canopus, 1·994; Alpha Centauri (the standard), 1·000; Arcturus, 0·726; Rigel, 0·654; Procyon, 0·520; Alpha Orionis, 0·484; Lyræ, 0·446; Alpha Eridani, 0·441; Alpha Crucis, 0·377; Alpha Aquilæ, 0·350; Antares, 0·404. Although the difference in the intensities of the light of these stars is very great, they are all, according to the old system, stars of the first magnitude. Now, on comparing the photometric results with the common naked eye magnitudes, he found, that if the latter be increased by the constant fraction 0·4142 (or $\sqrt{2}-1$), the numbers thus obtained will represent the respective distances of the stars, with which we are dealing, from our system, provided we assume that the intrinsic lustre of all the stars is the equal distance alone making the difference between them. Argelander affirms that the last stars visible to the naked eye are nearly nine times farther off than stars of the first magnitude.

It is a matter of importance to obtain an exact method of classing the stars according to the intensities of their light; because such a classification would be of great assistance in observing the changes which the light of some of them pass through. Sirius appeared to the Greeks of a red colour; whilst to us he shows a dazzling white. In ancient times, Castor was the largest star of the Twins; whilst, at this day, he is less than Pollux. Alpha Hydræ was classed as a star of the first magnitude by the ancients; and now he is not larger than one of the second. The seven stars of the Great Bear are continually changing their brightness, and they take it in turn to show one brighter than the others.

Some stars are periodically variable in light and lustre. One of the most remarkable is Omicron Ceti; its period is about 334 days. In its state of greatest splendour, which lasts about 15 days, it appears as a star of the second magnitude. It loses brightness for three months, is invisible for five months, reappears again, and gradually gathers light during the three succeeding months, when it attains its maximum state. However, there are irregularities in these phases; and Hevelius reports, that from October, 1672, to December, 1676, a space of four years, it was entirely invisible. Algol (Beta Persei) ordinarily appears a star of the second magnitude, and thus remains during $2^{d.}\ 14^{h.}$, at the end of which time its light suddenly diminishes, so that in $3\frac{1}{2}^{h.}$ it is only of the fourth magnitude. It then begins to increase, and in $3\frac{1}{2}^{h.}$ it has resumed its greatest lustre. Its period is thus about $2^{d.}\ 20^{h.}\ 48^{m.}$ Goodriche, who discovered this singular star in 1782, thought that its variableness is due to the presence of an opaque body, which, in its revolution round the star, intercepts its light; but some astronomers are of opinion that it has a rotation about an axis, and that thus brighter and darker parts of its surface are alternately presented to us. The star Eta Argi, placed in the centre of a nebula, has a singularly variable lustre. In 1677, it was of the fourth magnitude; in 1844, it was nearly as bright as Sirius; and though now gradually losing its brightness, it is still classed as of the first magnitude. Its variations do not seem to be periodical, but irregular, and its fluctuations spread over centuries. Delta Cephei changes from the third to the fifth magnitude in $8\frac{1}{2}$ hours. Beta Lyræ (Sheliah) takes $6^{d.}\ 9^{h.}$ to make a similar change. The sudden appearance of a star in 125, B.C., induced Hipparchus, it is said, to compile his catalogue of stars, the most ancient on record. In 380 of our era, a star appeared in the neighbourhood of Alpha Aquilæ, which for three months had the lustre of Venus, and then entirely disappeared. In the years 945, 1264, and 1572, brilliant stars made their appearance in that part of the heaven comprised between Cepheus and Cassiopeia, and it seems probable that they were one and the same body. The appearance of the star of 1572 was so sudden, that Tycho Brahe, returning home one evening from his observatory, was astonished to find a crowd of people assembled in the street gazing at the extraordinary visitor. It was then as bright as Sirius; and it continued to increase in size until it was equal to Jupiter in brilliancy, and it was visible in the daytime. It began to diminish in December of the same year, and by March 1574, it had vanished from the sky. On the 10th October, 1604, a star of the same kind appeared in the constellation Serpentarius, and was visible until October, 1605. In short, if we review the heavens with attention, and compare them with the catalogues which have been from time to time drawn up, we shall find that many of the recorded bodies are now wanting; and after making due allowances for errors, we may regard it as certain that several stars have really disappeared.

Distribution of the Stars in Space.—The three or four first classes of stars seem to be pretty uniformly scattered over the heavenly vault; but taking into account all those visible to the naked eye, we perceive that they increase rapidly as we approach the Milky Way. The accumulation of stars in this zone, and in its two branches, is exceedingly great; and, in fact, the light of the Milky Way is the result of the proximity and prodigious quantity of stellar objects in this part of the sky. Herschel declared it to be fathomless; but observers, using Lord Rosse's large telescopes, say that its extreme stars are seen through them of a notable size and brightness, and, consequently, that its profoundest parts are quite within the reach of those instruments. The Milky Way is not of uniform profundity. In places there are lacunæ, in others condensations. Those regions of the heaven corresponding to the extremities of an axis perpendicular to the great luminous band, are very poor in stars; that is, the stars are thickest in the neighbourhood of $6^{h.}\ 40^{m.}$ and $18^{h.}\ 40^{m.}$ right ascension, and they are least abundant in $1^{h.}\ 30^{m.}$ and $13^{h.}\ 30^{m.}$ right ascension.* From these facts and calculations made from soundings of the depth of the stars in different parts, it has been concluded that the stars which we perceive with the naked eye are a portion of the great stratum which we see edgeways when we look in the direction of the Milky Way. It would seem as if the earth and the system to which it belongs were placed near the centre of a comparatively shallow layer of stars, and that we look in the direction of its top and bottom when we cast our eyes on the heaven on each side of the Milky Way, and in the direction of its sides or edges when we look upon that luminous band.

The total number of the stars must be considered as infinite, in the literal sense of the word. Herschel counted 238,000 stars in the field of his 20 feet reflector, in 41 minutes of time; and it is believed that the more powerful telescopes, constructed since his day, render visible about 100 millions.

Nebulæ.—This name has been given to those luminous spots which are perceived in various parts of the heavens, many of which are visible to the naked eye. These objects are extremely diversified in their outlines and internal arrangement. Some have discs of feeble light, with bright clear edges, seen against a clear sky; some with resplendent centres gradually shade off into a faint luminosity, the exact termination of which is not discoverable; some strikingly resemble familiar shapes, globular, annular, spiral, &c.; others have not the least similitude to any form, natural or artificial; the light of some is entangled with that of stars, to which they have no relation whatever; others are seen through the Milky Way, itself a huge nebulæ, that becomes transparent under the telescope, and admits the passage of light from smaller nebulæ beyond.

When the telescope began to be applied to celestial investigations, it was seen that the more conspicuous nebulæ consisted of clusters of stars very closely set; and, as the instrument improved, the number of resolvable nebulæ increased. The elder Herschel was the first who undertook a systematic search for nebulæ; and, aided by his powerful telescopes, he discovered many that had not previously been seen. Those that he deciphered spoke for themselves; but there were a great number that resisted the utmost powers of his instruments, and he then conceived the daring hypothesis, which has been usually known as the nebular hypothesis. Such of the nebulæ of a round form as defied resolution, he regarded as stellar objects in the act of formation. He supposed that the centre or brightest portion contained the nucleus and attractive force, and that the cloudy light around was composed of luminous matter, which only required consolidation to become a sun or galaxy of stars—that it consisted of chaotic elements advancing to arrangement and organization. However, when Lord Rosse's great telescopes were turned to these objects, many of those which had baffled Herschel were at once resolved into stars; whilst, in other cases, that symmetry of form in globular nebulæ, upon which the hypothesis was founded, was no longer visible. Hence, the nebular hypothesis has been generally abandoned by philosophers, who now assume that distance alone makes all the difference between resolvable and irresolvable nebulæ. At any rate, it may be said, that nature has yet to be detected in "the act of condensing phosphorescent or self-luminous matter into future systems." It has been well said, that "every improvement of the telescope will put an end to speculations founded on observations made with less perfect instruments. Distinct nebulæ will be conjoined; dark spaces in the heavens, like those in the Serpent and in Ophiucus, will be filled with light; separate stars will be united with clusters or nebulæ, now invisible; round nebulæ will be supplied with curls and branches; uniformly luminous discs will appear in spots and streaks; and apparent condensations of nebulosity will shine in broken and irregular patches."

Sir William Herschel described three kinds of irresolvable nebulæ—1. Planetary nebulæ. 2. Stellar nebulæ. 3. Nebulous stars. The first class consists of objects to which rounded or slightly oval discs, sometimes clearly defined at their edges, sometimes with hazy borders, give a certain resemblance to the planets. Their light is perfectly uniform, or very slightly shaded, and sometimes it approaches in brilliancy to that of actual planets. These objects are of an enormous extent. Stellar nebulæ have a round or oval figure, and the light increases in intensity from their edges to the centre, so as to give the appearance of a pale or veiled star. Nebulous stars, on the contrary, present the beautiful phenomenon of a clear and brilliant star, surrounded by a perfectly circular disc, or by an atmosphere sometimes feebly luminous, and insensibly decreasing in all directions, at other times sharply terminated.

Amongst the most remarkable nebulæ, we may mention the nebula of Orion, discovered by Huygens in 1656.

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* The Right Ascension (R. A.) of a celestial object answers to the longitude of a terrestrial one; whilst North or South Polar Declination (N. or S. P. D.) answers to latitude. By the first we state the angular distance of a star from the meridian, reckoning from west to east, when the constellation of Aries is there. By the second we state its distance from the equator.

A nebular line, with a horse-shoe at each end of it, R. A. $18^{\text{h.}}$ 11′, N. P. D. 106° 15′.

In the greater nubecula of the Magellanic Clouds is a nebula resembling a number of loops united in the middle, like a bunch of ribbons tied in what is called a true lover's knot.

A nebula (R. A. $12^{\text{h.}}$ 43′ 36″, N. P. D. 149° 25′ 41″) resolvable into an extremely brilliant clustre of variously coloured stars, having the effect of a superb piece of fancy jewellery. These stars are greenish-white, two green, one blue-green, one red, one ruddy.

A nebula (47 Toucani) resolvable into a globular cluster of stars, very numerous and compressed, with a blaze of light in the centre, the stars seeming to run together. The centre portion is rose-coloured, and forms a fine contrast with the white light of the exterior parts.

The Magellanic Clouds are two conspicuous objects (*nubeculæ*) in the southern hemisphere, which have nothing analogous in ours, and are regarded as systems *sui generis.* They are of extraordinary complexity in their details, and consist partly of large tracts and ill-defined patches of totally irresolvable nebulæ, nebulosity of every degree of resolution and perfectly ascertained stars, partly of regular and irregular nebulæ, properly so called, globular clusters of every degree of resolvability, and clustering groups. The larger one, which is four times the size of the other, contains altogether 919 stars, nebulæ, and clusters. The regions in which these objects are placed are comparatively barren of stars and nebulæ; hence their effect on the spectator is increased by the foil of dark space surrounding them.

A nebula, curiously resembling a bust or facial profile—hence, termed the Silhouette Nebula.

The nebula in the constellation of the Fox, which was long known as the Dumb Bell Nebula, from its resemblance to that object, proves, when viewed through Lord Rosse's telescopes, to consist of two clusters in near neighbourhood, and ceases to have that exact elliptical termination which Herschel found in it.

In attempting to ascertain the law of distribution of nebular objects over the surface of the heavens, Sir John Herschel drew the following conclusions:—

Their distribution is not like that of the Milky Way, in a zone or band encircling the heavens. One-third of the total number is congregated in a broad, irregular patch, occupying about one-eighth of the whole surface of the sphere, chiefly situate in the N. hemisphere in the constellations Leo, Leo Minor, the body, tail, and hind legs of Ursa Major, the nose of the Cameleopard, the point of the tail of Draco, Canes Venatici, Coma, the preceding leg of Bootes, and the head, wings, and shoulders of Virgo. Within this area there are several local centres of accumulation, where the nebulæ are exceedingly crowded. The Nebulous System is distinct from the Sidereal, though involving, and perhaps, to a certain extent, mixing, with the latter. It has been conjectured, that the numerous comets, with their tails constantly in motion amongst the planets, must give the appearance of a nebula to our solar system when viewed from a remote point.

Double Stars.—Many stars, when examined by the telescope, are double or multiple—that is to say, they are resolved into two or more stars very near together. Several thousands of these objects have been discovered and catalogued. Among the stars of the first six magnitudes, we meet with 1 double star for 10 simple stars; among the stars from the sixth to the ninth magnitude, 1 double star for 26 simple stars; and among the stars of less magnitude, 1 double for 43 simple. Those parts of the heavens which are poorest in simple stars have the greatest number of double stars. However, the constellations of Perseus, Aries, Musca, Gemini, and especially Orion, which are out of the Milky Way, are very rich in double stars. Among the triple stars we may mention one in Orion, composed of two stars of the seventh and one of the tenth magnitude; one in the Lynx; Zeta in Cancer; Xi in Libra; two in Taurus; Psi in Cassiopeia, &c. In Orion, Theta is quadruple, and the four stars form a nearly regular square. In the middle of the square a fifth star has been only recently discovered; and as it has become so bright that it can be easily made out with a good telescope, it seems probable that it has only lately come into existence, and that it is at the present moment increasing in size. Sigma of Orion, an object immediately beneath the three stars, known as Jacob's Staff, is composed of 16 stars.

Now, close attention to the matter shows that the greater part of these multiple stars really form systems of themselves, and are not accidentally and optically viewed in a straight line, by reason of our position throwing one behind another. It has been observed that the angular distances of such stars, that is, their position with respect to each other, vary in such a manner, that one describes an ellipse round the other which occupies one of the foci. Calculations, as to the lengths of their orbits, founded a series of observations, give the following results:—Zeta Hercules, 35 years; Eta Coronæ, 43 years; Gamma Virginis, 182 years; Epsilon Bootes, 1,681 years; 65 Piscium, 3,077 years.

It usually happens that the two stars of which a double star is composed are of unequal size. Thus, Beta of the Great Bear (Mizar), is composed of two stars, one of which is of the third, the other of the fourth magnitude; Zeta Orionis (Rigel) of two stars, of the first and tenth magnitudes; and Alpha Lyræ (Vega) of two stars, of the first and fifth magnitudes. A great number of double stars present very striking contrasts of colour. The greater of two stars is usually red or orange, whilst the less is blue or green; and this contrast in colour sometimes take place in stars which are only optically near. Thus, Omicron Ceti (Mera) has a reddish yellow colour, whilst another star, 116″ distant, is pale blue. In some cases, the two stars of a double star have the same colour. The finest object of the kind in the whole firmament is Alpha Centauri. It is composed of two stars, and both are ruddy or orange. An occultation of one by the other is expected about 1867. The real diameter of the relative orbit of one star about the other cannot be so small as the orbit of Saturn round the sun, and probably exceeds the orbit of Uranus.

Distance of the Stars.—After much close attention, and an employment of the finest instruments, parallax has been detected in about 35 of the stars. The nearest star yet discovered is Alpha Centauri, the parallax of which is 0″·912. Hence, its distance from us is about 21 millions of millions of miles, or about twelve thousand times the distance of Uranus from the sun. A parallax of 0″·3483 has been found in 61· Cygni, and of 0″·25 in Alpha Lyræ. The smallest parallax discovered is 0″·00092. The distance of that star from us is consequently 224,500,000 radii of the earth's orbit, to travel over which space light would take 3,541 years. "Yet how small in all probability is this distance compared with those of some of the remoter nebulæ, which present themselves in the field of view in the most perfect, yet constructed as an almost inappreciable haze of light, though possibly constituting the accumulated light of a system of stars, not inferior in number and brightness to those which compose our Milky Way, of which the immense space comprehended within the range of vision of the naked eye forms an almost infinitesimal portion!"

SIMPSON AND SHIPTON'S IMPROVED RECIPROCATING STEAM-ENGINE.

A modest pamphlet has just been issued by Messrs. Simpson and Shipton of Manchester, the inventors of the hydraulic governor, figured and described by us last month, descriptive of their new reciprocating steam-engine, in which they aim at the direct conversion of rectilinear into circular motion. Though not exactly a rotatory engine, the inventors have deemed it necessary to preface their statements by a half apologetic introduction, in which they make use of a line of argument very similar to our own, on the occasion of our explanation of Davies' Rotatory engine in a recent number. From the latter part of this section of the work, we shall make an extract, by way of explaining, in their own terms, the objections which they propose, in their new engines, to remove.

"The loss of power that must arise from the conversion of rectilinear into circular motion, is well known, particularly in quick speeds, from the fact of a mass of metal being brought suddenly to rest, and instantly reversed. In spinning, or any process of manufacture that demands stability of motion, this reversing of material is severely felt; hence the adoption of short stroked engines and quick speeds,—and although in a measure they remedy this evil, they are still imperfect. If a direct continuous motion, therefore, be obtained, there is no doubt that it would present great advantages to the manufacturers. If there be inequality of motion in the first mover, it will be conveyed throughout, and be most severely felt in those machines which require quick speeds. The loss of power, arising from this cause, is very considerable in the locomotive. The adoption of the ordinary engine for this latter purpose, entails many disadvantages;—we are tied down to size and weight, and the position of the weight does not always suit the position of the power, that power being confined within restricted limits. Connecting rods, acting at angles, have also to be of sufficient length to overcome the obliquity, or the power is lost; this entails length and weight,—and if we increase weight, increased power will be required to move that weight, and reverse the direction. Pistons in locomotives travel greatly above the speed considered beneficial for them, and many modifications have been, and are, adopted for reducing their velocity. Simplicity will, however, maintain its position, and the more the working parts of engines are increased, the more power will be required to work those parts; thus one point is gained to the sacrifice of another. The action of two cylinders, one being in power while the other is at rest, must produce irregularity of motion, from the strain being first on one side and then on the other of the framing; and this oscillatory motion called forth the three cylindered engine of Mr. Stephenson. Outside cylinders present many advantages over inside cylinders, in several respects,—such as in being more easily constructed, and in affording greater facility of access to their parts; but in consequence of the power being so placed, and the weight adjusted accordingly, they cannot be so advantageously employed, and the strain is much greater. In marine engines we labour also under considerable disadvantages. There is no doubt that the screw propeller would be more generally adopted, if engines were made to work direct upon the shaft, and although in some cases they do so, yet in the modes usually adopted, at what cost? The scientific know the merits of the screw propeller, which, to be brought into general use, only requires suitable means of propulsion. Economy of space, and all working parts being under the water line, are two important objects, particularly in vessels of war, which requisites the ordinary engine does not sufficiently supply. In whatever way the size or power of an engine be increased, the head-room is infringed upon, or otherwise the working parts are cramped into scarcely working space. An engine, however, whose motion is self-contained, will doubtless remedy many of these defects."

Fig. 1 of the annexed wood-cuts, is a transverse sectional elevation of the engine; fig. 2 is a corresponding view at right angles, a portion of the cylinder being in section. A, Is the steam chamber, supplying the place of the ordinary cylinder; B is an eccentric, keyed fast on the shaft, C, and answering as a piston; D is a plate having a true planed surface, against which the piston or eccentric rubs, and at the same time revolves. Against the back of this plate, steam is introduced from the main steam pipe, by means of the small pipe, E; and there are likewise springs to overcome any extra pressure. This plate acts beneficially in cases of priming, the water passing from the top side of the piston to the bottom, or *vice versa*, until it escapes. F, Is a planed surface, similar to the surface of D, and perfectly parallel with it in every direction;—these surfaces are the only two against which the periphery of the piston comes in contact, there being a clearance in the other parts of the steam chamber for the piston,—thus totally avoiding the boring of cylinders, which is a great item in the expense of engines of ordinary construction. G G, Are rods radiating from the crank shaft, supported on gudgeons forming part of the crank shaft pedestals, and are for the purpose of carrying the piston, B. H H, Are connecting rods, or, in fact, merely drag links, through which the power is transmitted from the upper to the lower cranks, which, in this instance, are keyed on at right angles. The ends of the piston come in contact with the side plates, I I, which are planed surfaces. The method of packing the ends of the piston is by means of a ring of metal fitted into a conical seating, and cut open on one side, and caused to be expanded by a wedge acted on by a spring, and made to rise on its seating, thus elongating the piston. The advantages resulting from this method of packing are particularly worthy of notice. It will be seen that the peculiar motion produced by the eccentric piston travelling from one end of the cylinder to the other, causes the ring in the ends of the piston gradually to traverse round,—thus maintaining a beautiful wear, as the same parts do not go over the same lines twice together. The plates, I I, have slots in them, to allow the shaft, C, to traverse clear, as the piston, B, must cause the shaft, C, to move a distance equal to the eccentricity of the piston, on account of the eccentric piston being confined within its own diameter; and these slots are so arranged, that the side plates will come over the cranks, and at the same time afford easy access to the packing rings, which can at any time be adjusted without removing a single nut, and the wear of the interior of the cylinder against the side plates may be easily inspected. The rods G G and H H, are always in a perfectly parallel position to each other; and, consequently, the power from the piston is conveyed to the lower crank shaft through direct lines, and not through any angles, to the centres of resistance. The rods H H, being the means through which the power is conveyed, and F F, the resistance, it is not material whether short or long rods are used. The admission of steam to the top and bottom of the piston, alternately, is precisely the same as in the ordinary engine, but in this case the valve for admitting it is rather different from those hitherto constructed; but one of the ordinary description would meet the purposes of this engine as well as any other, as its office is precisely the same. The description of valve used here is on the equilibrium principle, exhausting through the back at K, while the steam enters at L, and working between two planed surfaces, as shown in the drawing; the packing is similar to that employed for packing the ends of the piston, viz., a ring of metal fitted into a conical seat and cut open on one side, with a wedge inserted, and acted upon by a spring,—thus causing it to expand and rise on its seating; but even the elasticity of the ring, with a "slip" fitted across the joint to prevent the steam blowing through, will overcome the difficulty,—thus avoiding the necessity of the wedge and spring. Its advantages are simplicity, ready exit for the exhaust steam, and adoption of the equilibrium principle, which is very desirable, particularly in quick speed engines, as it is much more easily worked, and there is less strain on the working parts. The method of working this valve is by an eccentric, keyed on the lower shaft, and communicating the motion to the levers, which are fixed on the weigh shaft, and from thence to the valve. The steam chamber, or cylinder, is attached to the entablature, which is carried on columns resting on the foundation plate, and firmly bolted together, and thus is self-contained, and requiring little foundation, compared with the ordinary engine.

Fig. 1.

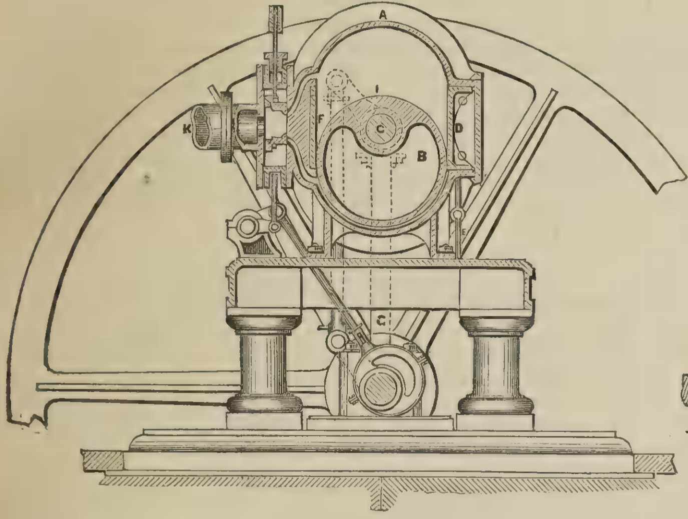
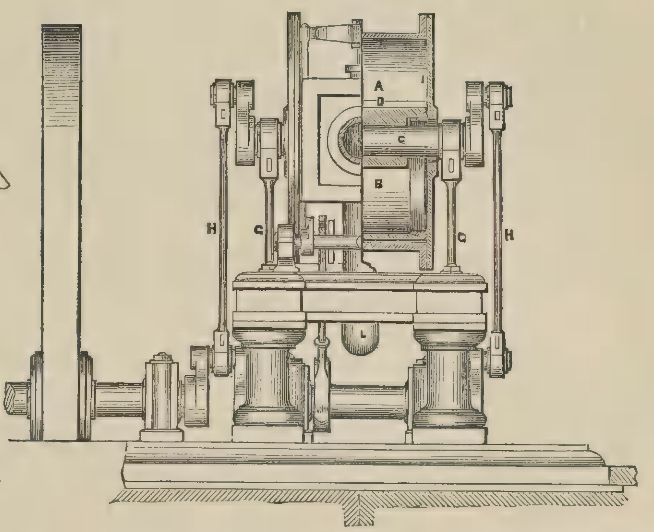


Fig. 2.



The great feature of this engine is an eccentric, revolving in its own diameter, the action of the steam on the piston being the same as in the ordinary engine; the piston being driven to and fro in the steam-chamber, and having centres to overcome as in it, the only difference being the method of obtaining the revolving motion out of the piston direct, instead of through the medium of a crank—the piston, in this case, being the crank. The cranks keyed on each end of the piston-shaft are mere appurtenances, and do not regulate the stroke. On reference to fig. 3, it will be seen that the piston is on the bottom centre; fig. 4, at half stroke (and then most effective); and fig. 5 on the top centre, the piston having then travelled half a revolution, and the shaft a distance

Fig. 3.

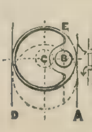


Fig. 4.

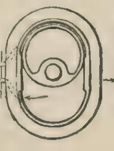


Fig. 5.

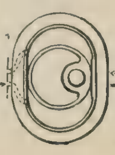
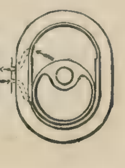


Fig. 6.



equal to the stroke or eccentricity of the piston; and in consequence of the full body of the piston being displaced, and not only the full side of the eccentric, the power is as the full area of the piston, or cross section of the steam-chamber, multiplied by the stroke or space moved through. Thus, in fig. 6, A to D represents the cross section of the steam-chamber, and B the centre on which the piston turns. If, then, there is effect from B to D, and if there is a counteracting pressure from A to B, it will take from B to C to overcome it; but if there is any effect from A to B, then we have B D plus whatever effect arises from A to B. The steam acting against the surface, A E, must exert a pressure sufficient to overcome A B, B being the centre on which the piston turns; consequently, by whatever amount B E exceeds A B, so there will be effect, or in some such ratio. And it will be seen that A B consumes but little steam, therefore the power given out will be in the same proportion, the piston itself travelling bodily before the steam, and not moving into space pre-occupied, the same as if B were a fixed centre.

An engine of this construction is now being worked by the inventors alongside one of the ordinary reciprocating class, both deriving their steam from the same boiler. The stroke is 8 inches, and the revolutions 150 per minute. The consumption of fuel for a given amount of work is given as closely approximating to that of the engine with which it is being tested; but a longer trial is required to show the relative standing of the two in this respect. The arrangements for compensating the wear on the piston's periphery and ends are peculiarly ingenious and effective; in the latter case, the motion being elliptical, the rings are caused to travel round, and the side plates, on which they rub, gain a very high polish.

The peculiar advantages claimed for the engine are cheapness of construction, the dispensing with costly foundations, economy of space, speed of working, with a slow movement of the piston, and a direct driving movement through straight lines. We shall, at a future time, take steps to note the value of the two great points of economy of fuel, and durability of working parts, both of which require some time for development.

BRYSON'S SELF-REGISTERING TIDAL AND METEOROLOGICAL CLOCK.

(*Illustrated by Plate* 35.)

This very comprehensive instrument is erected in the passengers' waiting-room, at the head of Glasgow harbour, where it has now been in constant and regular action for several months. It was commissioned by the river trustees from Messrs. Bryson, the eminent chronometer-makers of Edinburgh, who have produced in it a most ingenious and valuable combination of indicators, six in number. These are—

1. The Clock.
2. The Barometer, registering each hour the pressure of the atmosphere.
3. The variations of the Tide in height and time.
4. The force of the Wind, expressed in lbs. avoirdupois on a square foot of surface.
5. The direction of the Wind at all times.
6. The Rain Guage, exhibiting the amount of rain fallen, the time of its descent, and its continuance.

Fig. 1 of plate 35, is a front elevation of the works of the instrument, with a side view of the clock, A, which gives motion to the barrel. The clock is carried upon the top of a cast-iron frame plate, which also supports the index-barrel, the whole being set upon cast-iron standards, about 3 feet 6 inches high. The registering barrel, B, is fast upon a long spindle, supported in adjustable centres at top and bottom. It is driven by a pinion, C, on the second motion spindle, working into the wheel, D, on the bottom of the barrel of the clock. It makes one complete revolution in a week. The barrel is set out, as explained by the horizontal lines, into five compartments, for the several indications figured on the plate. The index-paper, carried by the barrel is arranged to receive a week's tracings. It is divided by vertical lines into days, with subdivisions for the 24 hours.

A, Is the clock supported by a strong cast-iron frame. The pinion, C, gives motion to the wheel, D, on which rests the cylinder, B. This cylinder makes one revolution per week, and bears the ruled paper on which the indications of the instruments are registered.

No. 1 is the pencil-bearer attached to the rain-guage, which is a copper cylinder, having a copper float inside, with an upright rod, to which the pencil-bearer is attached at W.

L, Is the entrance-pipe, conveying the rain into the guage from the receiving-funnel, fig. 4. The funnel is shaped according to the plan of Thomas Stevenson, Esq., C. E., preventing the resilience of the rain. *f*, Is a lever attached to the stop-cock of the rain-guage, and to a movable lifter at *e*, which opens the stop-cock once in 24 hours, permitting the escape of the rain from the cylinder after registration.

No. 2 is the pencil-bearer of the anemoscope, which is attached to a square rod depending from a gun-metal box, H. This box is raised or depressed by the revolution of the hollow screw, F, which is continued at F, fig. 3, and is rotated by the vane, P.

No. 3 is the pencil-bearer, registering the force of the wind. This is attached to the anemometer, P, the invention of Mr. Richard Adie, optician, Liverpool. It consists of a copper cylinder, containing water to the level of the second dotted line below the letter P. An inverted copper cylinder is suspended by a cord passing over the pulley, S. On the same axis is placed an involute of a circle, to which is hung a counterpois weight, as seen through the vessel, P. Z, Is an inverted jar, containing water, supplying loss by evaporation in the cylinder. E, Is a tube communicating with the inner cylinder, admitting the air to press on its upper surface. O, Fig. 3, shows the aperture which admits the air to the tube. As the pressure of the wind increases, the inner cylinder is raised, which forces up the rod, T, to which the pencil is attached.

No. 4 exhibits the pencil-bearer, attached to the tide-guage by a rod, E.

Fig. 2 is a view of the tide-guage; it is composed of a large wheel, on the circumference of which is a gutta percha line, depending over a roller into the water at C. B, Is a counterpoise passing over a smaller wheel, so as nearly to balance the weight of the float C. E, Is a continuation of the rod E, fig. 1. F, Is a roller acting on by an involute of a circle, A. As the tide rises or falls the involute raises or depresses the rod, E, and indicates the amount, by the pencil on the cylinder.

No. 5 is the pencil bearer of the barometer attached to a float of ivory, which rests on the surface of the mercury of the tube, M. I, Is a lifter which revolves once in an hour, and presses on a horizontal detent with sufficient force to cause a small horizontal pencil mark on the paper.

A very considerable amount of ingenuity has been exercised in bringing all the various indicating movements to bear upon the receiving-paper on the barrel, and the fact that each performs its allotted duty in an accurate manner, is evidence that the skill of the contrivers has not been misapplied.

THE MECHANIC'S LIBRARY.

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REGISTERED DESIGN.

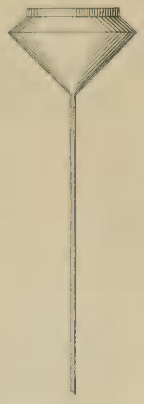
WEST'S COMBINED CLAY PREPARING AND DRAIN-TILE MACHINE.

This is an ingenious combination of two distinct processes in tile making, invented by Mr. West of Riccarton, Linlithgow. The raw clay is placed in a long horizontal box, fitted with a central horizontal shaft, carrying a series of knives or screw blades, and forming an efficient pug mill for working and traversing the clay to the moulding apparatus. The working shaft receives its motion through the medium of suitable gearing, and the clay is gradually carried along the box by the action of the knives, until it reaches an opening in the bottom at one end. Directly above this opening, a broad curved blade upon the knife shaft, is continually revolving, and each time that it approaches the bottom of the box, it forces a portion of the clay through into the screening box below, where the stones and foreign matters are removed from it by the action of a species of piston screen. This screen embodies an important improvement—as, in place of a fixed grating, through which the clay is pressed by the action of a solid sliding piston, the latter is formed like a box, with the top and one end removed. The periodical supplies of clay are given to one end of the box in which the screen works, when the latter is at the other, so that when the return stroke brings it forward, with the screening end first, the clay is squeezed between the door of the box, and the travelling screen. The clay thus enters the screen by the perforations, whilst the stones remain in the outer screening box. The cleaned clay is then conveyed along to the tile chamber in the screen itself, and here it is forced through the necessary die, by the action of a piston, as usual. To remove the accumulations of stones from the screening box, the door at the end may be opened periodically by hand, and the refuse ejected at once; or, after the machine has been some time in action, so as to accumulate the stones, they may be forced out in small portions at each stroke, by slightly elevatingthe door.

The whole of this design is registered as novel and original in shape and configuration.

BRYSON'S SELF REGISTERING
TIDAL & METEOROLOGICAL CLOCK.

Fig. 4.



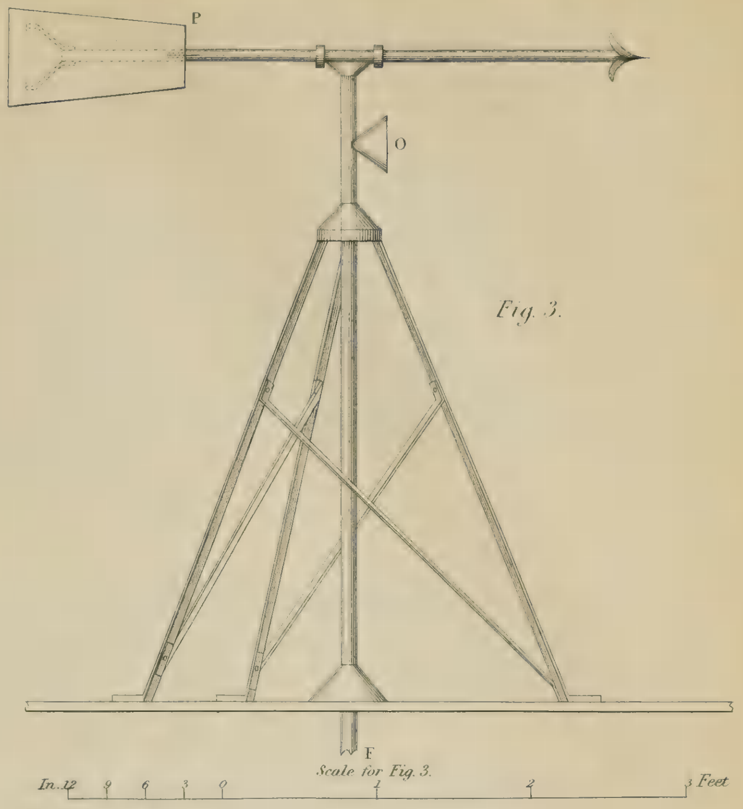
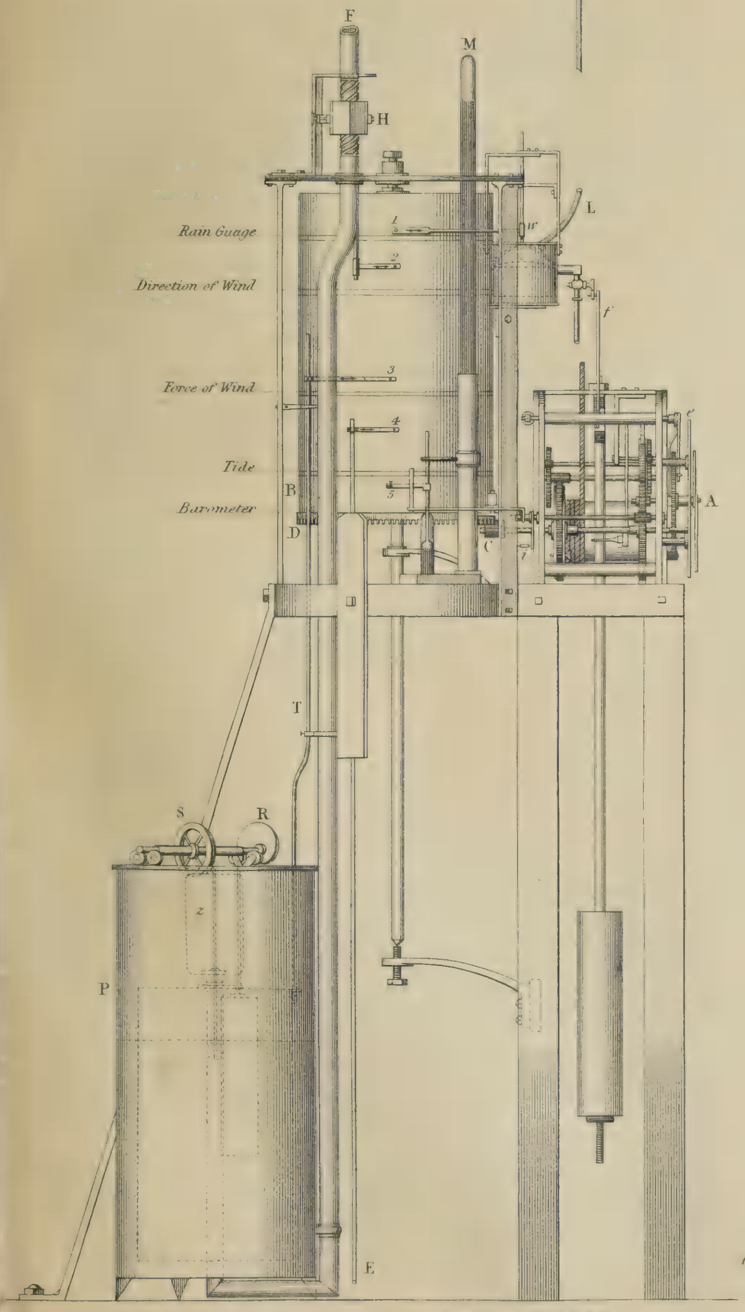


Fig. 3.

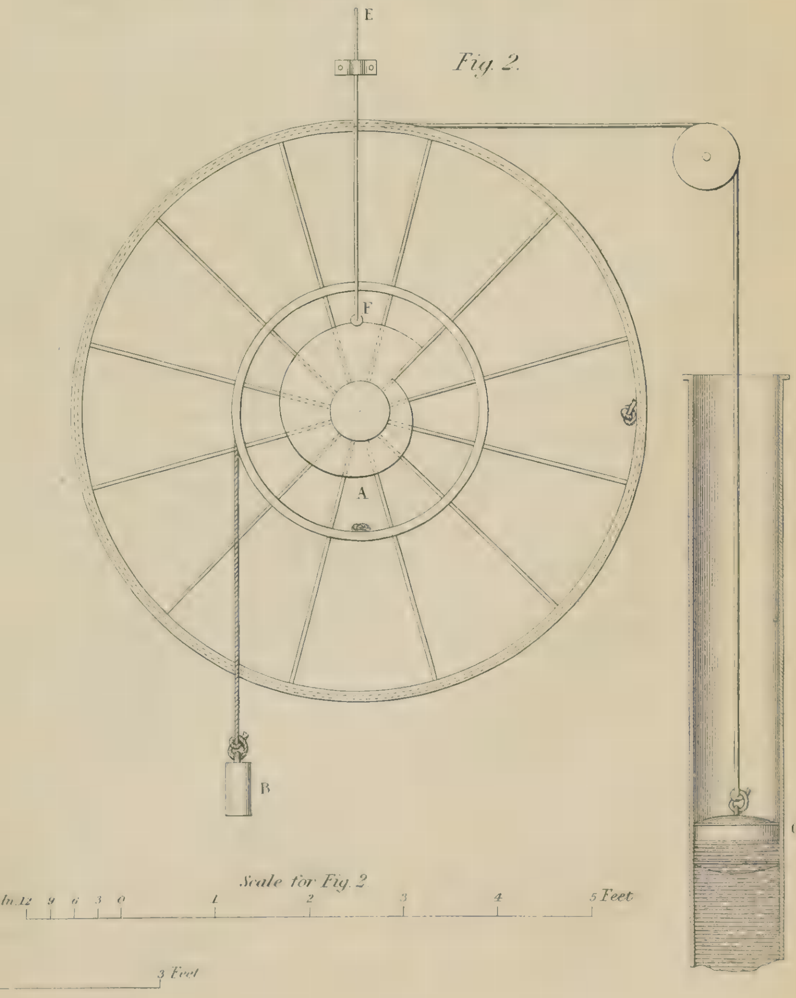
Fig. 1.



Scale for Figs. 1 & 4.

In. 12 9 6 3 0 1 2 3 Feet

Fig. 2.



W. Johnson.
nt Office Glasgow

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REVIEWS OF NEW BOOKS.

THE MARINE STEAM-ENGINE. London: Hebert, 88 Cheapside.

(*Second Notice.*)

We have said enough in our former notice of this work, to show its strong claims upon the consideration of the working engineer, as an easily comprehended text-book for his guidance in matters of practice; and we shall now take advantage of its pages, in offering some pointed remarks upon a subject to which our attention is so frequently called by uninitiated inquirers.

"*Methods of Measuring the Efficiency of Steam-Engines.*—The efficiency of an engine is evidently the amount of *useful* work it can accomplish. Now the *useful* work of an engine is the product of the resistance it can overcome, multiplied into the space through which that resistance is moved. Hence if P represent the number of pounds a steam-engine moves, and v the number of feet through which that resistance is moved in one minute, $P \times v$ is the useful work of the engine. Now, it is found that this product for any tolerably-sized engine requires a great number of figures to express it; and it is on that account not only cumbrous, but beyond the powers of the mind to realise at the first glance; on which account it was thought advisable by Watt to divide the product so obtained by some large number, and so to obtain the result in fewer figures more readily appreciable. The first engines made by Watt and others superseded the use of horses in pumping water out of mines; for which reason it was proposed to compare the work of an engine with that which it was supposed a horse would do. This quantity, *i. e.* the product of the weight a horse would raise in lbs., multiplied into the height in feet through which he would raise it in a minute, was considered to be 33,000; and therefore, from the time of Watt downwards, the measure of an engine has always been $\frac{P \times v}{33000}$, and this is called the horse-power of the engine.

"*To obtain the Horse-power of an Engine.*—1. If an indicator can be used, the readiest plan in an engine actually at work is to get, by means of the indicator, the pressure on the surface of the piston: from this a deduction must be made on account of the pressure of the uncondensed steam and the friction of the engine, the result will give the effective pressure. (See *Indicator and Dynamometer*, p. 26.)

"Again, the space passed over by the piston in one minute may be easily got, by multiplying the number of revolutions of the engine by the length of the up and down stroke.

Let now P' be the effective pressure on the piston, v' its velocity.

Then the effect produced by the steam $= P' v'$ (neglecting friction and useless resistances).

But, by the principles of mechanics, $P' v' - P v$.

Hence the horse-power of the engine $= \frac{P' v'}{33000}$.

"*On Mercantile Horse-power.*—The method proposed in the last article is evidently only applicable after the engine has been made and commenced its functions. But it is necessary to have some definite rule for gaining an idea of the power of an engine to be constructed, otherwise contracts could not be entered into between the manufacturer and the party for whom the engine is to be made. And therefore, in sending in tenders for engines for her Majesty's ships, the calculation of the power is made by allowing the effective pressure on each square inch of the piston to be 7 lbs., and the speed of the piston as follows:—

For 3	ft. 0	in. stroke,	30	revolutions	per min.	=	180	ft.	per min.
3	6	„	27	„	„		189		„
4	0	„	$24\frac{1}{2}$	„	„		196		„
4	6	„	$22\frac{2}{3}$	„	„		204		„
5	0	„	21	„	„		210		„
5	6	„	$19\frac{1}{9}$	„	„		216		„
6	0	„	$18\frac{1}{2}$	„	„		222		„
6	6	„	$17\frac{5}{33}$	„	„		226		„
7	0	„	$16\frac{1}{2}$	„	„		231		„
7	6	„	$15\frac{11}{15}$	„	„		236		„
8	0	„	15	„	„		240		„
8	6	„	$14\frac{6}{17}$	„	„		244		„
9	0	„	$13\frac{2}{3}$	„	„		247		„

And hence the following rule adopted by the Admiralty for horse-power:

$$\frac{7 \times \cdot 7854 \times d^2 \times \text{feet per minute}}{33000}$$

$$\text{or} \quad \frac{d_2 \times \text{feet per minute}}{6000} = \text{nominal horse-power.}$$

"*To find the Horse-power from the Evaporation of the Boiler.*—The following rules, adapted to logarithmic computation, are formed from valuable investigations by Comte de Pambour, the substance of which is given below. They are, however, attended with great difficulties in practical application, from the fact that the effective evaporation of engines is not known. If we knew how much pure steam a given boiler is capable of evaporating in a given time, these formulæ would give us everything that we could desire; but unfortunately this is still a desideratum; and even if the supply of water to boilers of various capabilities were ascertained with the view of getting the desired result, still we must remember that the steam generally used in engines is surcharged with watery vapour, and therefore not altogether effective in producing elastic pressure. And the state of the steam will vary from time to time in the same engine according to the resistance the engine meets with; for it is pretty evident, the purer and more elastic the steam the better the effect. The investigations connected with this subject are given below, and, although independently made, are based on those of Comte de Pambour.* Practical rules deduced from these investigations will now follow."

The matter is here plain enough, and may serve as notes of reference for those who are not quite clear on the score of real and nominal power.

What is said with reference to altering the rate of the wheel to obtain greater speed, is equally clear in elucidating an important point.

"The rate at which the wheel revolves depends on the surface of the paddle-boards, but the speed of the ship is independent of their size. And therefore, whenever we are able to make use of all the steam the engine requires, no gain would be effected by diminishing the surface of the floats. The only effect would be to increase materially the consumption of fuel, without obtaining a proportionate increase of speed. But, on the other hand, if the wheel revolve so slowly that a portion of the steam escapes by the safety-valve, then we see by equations (4) and (6) that (by diminishing r, that is) by reefing the wheels, the speed of the ship is increased, and that of the piston is increased in a greater ratio (the one depending on r, and the other on the cube of r); so that a small amount of reefing will give a considerable increase of velocity to the piston, and therefore enable the engine to consume all its steam.

"In reefing the wheels, however, there would be no practical gain in the speed of the vessel, if a portion of the floats came above the surface of the water, for that would be effectually diminishing the surface of the float, and therefore would be increasing the speed of the engine without producing any effect on the speed of the ship.

"If by means of multiplying gear, or reefing, or otherwise, the speed of the ship and engine be increased, it will be found (see 7) that the speed of the engine varies as the cube of the speed of the ship.

"*Example.*—The number of revolutions of a tug-vessel when towing was 16, and the rate was 4 knots. The multiplying gear was then set in action, and the number of revolutions was 20; find the rate of the vessel.

"From what has been said,

$$16 : 20 :: 4^3 : V^3$$

$$\therefore \quad V^3 = \frac{64 \times 20}{16} = \frac{5}{4} \times 64$$

$$= 80$$

$$\therefore \quad V = \sqrt[3]{80} = 4{\cdot}3 \text{ nearly."}$$

A few pages on the "Relative Motion of the Slide-valve, Gab-lever, and Eccentric," by Commander Shortland, R.N., and some deductions on the Government Report on Coals for the Steam Navy, close the volume, or at least bring it to the point where the tabular matter commences. Amongst the latter is a well-compiled table of paddle and screw steamers in the navy, with a list of steamers building, all of which will be found useful for the practical readers of the volume.

OBSERVATIONS ON THE BRITISH MUSEUM, NATIONAL GALLERY, AND NATIONAL RECORD OFFICE, with Suggestions for their Improvement. By James Fergusson, M.R.I.B.A. Pp. 94. Plates. London: Weale, 1849.

Our public buildings are always sore subjects of discussion, for every one has, at least, some talent in the way of fault-finding, which he scruples not to exercise upon them. Mr. Fergusson is one of the few critics, who, whilst they condemn, offer reasonable suggestions for improvement; and for this reason, as well as for the generally judicious tone of his remarks, he will command an amount of attention which does not often fall to the lot of similar productions. In the British Museum are exhibited two great failings—inordinate cost, and an inadequate result. Since its foundation, £345,000 has been spent on collections, whilst more than £700,000 has been spent in housing them. Surely this is a very questionable disproportion; and we cannot be surprised at the remarks which it has called forth—and the more so, when, instead of a magnificent and well-contrived building, we have such an inconvenient and unsatisfactory one as the British Museum.

In giving us his opinions on the work, our author makes a careful step-by-step survey of the details, with the air of a man who wishes to deal even-handed justice, giving his award according to the pure evidence he adduces. Beginning with the library, he says—

"The first part of the Museum erected, and the one I shall consequently first notice, was the east wing. When his Majesty George IV. presented his father's library to the institution, it was very properly determined that it should be kept separate from the general collection, and in an apartment designed on an appropriate scale of magnificence. To contain it, therefore, the great eastern gallery was erected, 300 feet long, 40 feet wide, and 30 feet high. Whether or not a room between seven and eight times the length of its breadth was the form best adapted to the purpose, will be presently discussed. The architect had at least the authority of precedent for the form he adopted, almost all libraries being more or less in the form of galleries. The reason for this, however, is

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* The steam in the steam-chest of a boiler is in a different state from what it would be if it were shut up in a vessel apart from the water which generated it; for in the latter case it might be heated and cooled again, and its elasticity might be increased by diminishing the volume, and afterwards expanded, and it would obey the same laws as other elastic fluids; but such is not the case when in contact with the water from which it was formed, for then additional particles are continually being added to the original steam, or returning from it into the fluid state. Experiments have been made at various times for the purpose of establishing some law connecting the pressure of the steam with its density, but not with any satisfactory result. Empirical formulæ have been proposed by Dulong, Arago, Southern, Tredgold, and others, giving a relation between the pressure and temperature; but these are too complicated to be made available for practical purposes. After giving these, and showing the way in which they ought to have been turned to account, M. de Pambour gives one of his own, which, he says, sufficiently accords with facts to be practically useful, and has the advantage of being tolerably simple when introduced into investigations.

Let $S =$ the quantity of water evaporated each minute;

$V =$ the quantity of steam formed from it under the pressure p (in lbs. per square foot).

Then $\frac{V}{S}$ is called the relative volume of the steam under the pressure p;

$$\text{and} \quad \frac{V}{S} = \frac{1}{a + bp}$$

$$\text{where} \quad a = \cdot 00004227$$

$$\text{and} \quad b = \cdot 000000258$$

Again, it A be the area of the piston, and $n =$ the number of strokes in a minute, l the length of a stroke, and c the clearance of the cylinder, the space $A\,(l + c)$ is filled with steam at each stroke; and therefore in n strokes the volume of steam $= n\,A\,(l + c)$. But $n = \frac{v}{l}$; and since the volume of steam is V $\therefore V = \frac{v\,A\,(l + c)}{l}$.

> generally obvious, for in most instances the book-cases are arranged along the walls, and a long room has, from its form, a greater surface of wall than a more compact one. In this room, for instance, there exists 680 lineal feet of wall, but if the room had been 110 feet each way, though the number of square feet of floor would have been about the same, the wall space would have been only 440 feet.
>
> "Another reason in most libraries is, that persons using them, generally go to cases, take down the books they want, and sit down to read them there; and as other parties may be so employed also at the same time, or talking on literary or other subjects, it is a great convenience to students to be able to scatter themselves as far as possible, to be out of reach of hearing any conversation that may be going on in any other part of the room. These are, I believe, the principal, if not the only reasons for the usual arrangement: but neither apply to a public library; for where students are not allowed to read, the second is inapplicable; and where space sufficient can be obtained, the wall is not the best place for the book-cases, in the first place, because the windows being there also, it is the worst lighted, and the most exposed to damp; so that this reason cannot be used in defence of the present arrangement, while its inconvenience is manifest, from the great distance the librarians and attendants are obliged to traverse to reach the books they want. This is, perhaps, not so much felt in the library itself; but the manuscript department and Grenville library are by this arrangement removed to the distance of more than 300 feet from the reading-rooms, where they are to be consulted; and I need not point out the extreme inconvenience and delay that occur, from every reference or message being transmitted such a distance, besides the great fatigue and inconvenience of carrying heavy books and manuscripts backwards and forwards over such a space.
>
> "In the centre compartment of the north wing, for instance, we have a room containing, as nearly as may be, the same number of lineal feet of book-cases, measuring on the floor; but with this advantage, that no book is at a greater distance than 100 feet from the bar of the reading-room, and that, to reach the room beyond, the attendants have only to traverse 84 feet instead of 300, which is an advantage not easily over-estimated in such an establishment.
>
> "Another point to be considered, in comparing these two rooms, is, that owing to the immense number of lineal feet of wall required for such a room as the king's library, when, especially, one of those walls is reveted with ashlar-work, the one room would cost twice as much to build as the other. If, of course, length and size were the only elements of beauty or magnificence, we ought not to grudge the extra expense to do honour to so magnificent a gift. But I am convinced, that if the proportions of the king's library had been the same as those of the room in the north wing, or rather say 110 feet by 70, or some such proportion, and the £20,000 that might thus have been saved, had been spent in the architectural decorations, by introducing marbles and painting, and a richer style of ornament, a far more beautiful and splendid apartment would have been produced, not to mention its superior convenience.
>
> "Alongside of the great room, a range of book-closets has recently been erected, which was avowedly an after-thought, as those who superintended the original design quite forgot what, in an institution of this sort, is really the most important consideration—which is, to provide for any future increase or extension; and they are already forced to eke out their space, by patching and contriving, or by any expedient, however incongruous and inconvenient it may be.
>
> "If the king's library is inconvenient from its extreme length, this is much more so, and without any excuse on the score of magnificence and architectural effect, which is not here aimed at, as the whole is more like the cabin of a cargo steam-boat than anything else. But besides this, its incongruity with the room next it—and, indeed, with the whole of the rest of the building—is most painful. In the king's library, for instance, estimating the number of books at 62,000,[*] each volume has six cubic feet of space allowed it. The dimensions of this room are 300 feet by 18, and its height is 15[†] feet, while it is calculated to contain 85,000[‡] volumes, or allowing less than one cubic foot to each. I admit that the royal books are entitled to more space than the national ones, but twice the space allowed to the one should surely suffice for the other—or three times, at all events. But surely there is a gross incongruity in allowing one six times as much as the other. Either the national library ought to be better accommodated, or considerable economy might have been exercised in arranging the other."

The reading-rooms he characterises as ill-arranged, dark, and quite unfit for their real purpose of quiet study. With the exception of the Egyptian sculpture gallery, all the depositories of sculpture are alike condemned; and so on, with here and there a redeeming feature, throughout the whole. We can hardly understand how, with all these architectural faults to answer for, Sir Robert Smirke slips through the fingers of his examiner, without a scorch upon his professional reputation. If his building had been esteemed in the eye of the world, the world would have accorded him his meed of praise; being then in the reverse position, possessing a glorious minority of admirers, our judgment must pronounce accordingly.

In the section of Mr. Fergusson's book which treats of a proposed improved form of building, he states that the present amount of accommodation might have been obtained for one-sixth of the sum which has been spent; and to prove his case, he takes, as an example, the large flax-mill of Messrs. Marshall at Leeds, the cost of which was something more than £27,000. With this as a ground-work, he calculates that room for a million of volumes might be obtained for £30,000.

The second portion of the book refers to the existing National Gallery and the proposed Record Office. He proposes,

> "In the first place, to remove entirely the sculpture, and the whole department of arts altogether from the British Museum, and to build galleries for its reception, either in the rear of the present National Gallery, or to rebuild that institution on some other spot capable of providing accommodation not only for the pictures, but also for the statues of the nation, so as to join these two departments, and to make one great national repository of fine art.
>
> "In the second place, to remove also from the Museum, the department of natural history. This may be effected either by sending the minerals and fossils to the Museum of Economic Geology in Piccadilly, and erecting a separate institution for the specimens of animated nature, or by erecting a separate institution to contain the whole three kingdoms.
>
> "Lastly, by removing all the records to the British Museum, converting the present statue galleries into record depositories, for which they seem to me as admirably adapted as they are ill suited to the purposes for which they are now applied: thus making the British Museum the great depository of all the printed and written treasures of the nation.
>
> "We should then have three distinct, well-defined, and appropriate departments, instead of the present jumble; and all this could, I believe, be effected for the same sum of money as we are now prepared to devote to accommodate one department alone, leaving the others in their present deplorable state."

Without the assistance of the accompanying plans, it would be impossible to enter further into the detail of the alterations, for particulars of which, reference must be had to the work itself. As we close it, we must express our obligations to Mr. Fergusson for his well-meant endeavours at improvement, his clear exposure of the faults, and his shrewd remarks upon the good points of his subject.

ON COPYRIGHT IN DESIGN IN ART AND MANUFACTURES. By T. Turner, of the Middle Temple. Pp. 114. London: Elsworth. 1849.

Mr. Turner divides his book into four sections. The first treats of the nature and value of design copyright; the second of historical and statistical notices; the third, of the principles of the legal right as now administered, including some suggestions as to the extension of the right; and, lastly, the points in practice necessary to be attended to, among which will be found those relating to the right before publication, the advantages and mode of claiming the right, the exercise and transfer of it, and the breaches of the right, and remedies for such breaches. A chapter on the comparison of the kinds of property in invention follows, and a very full appendix, comprising the statutes in force, the rules issued by the registrar of designs, tables of cases, and foreign statistics, conclude the work.

It will be at once observed that the author takes a comprehensive view of the matter, and the book is, therefore, likely to be useful as well to the general reader and the inventor, as to that part of the legal profession whose attention is more particularly directed to the law of this kind of copyright.

After the careful researches which he appears to have made, Mr. Turner has arrived at conclusions respecting extending the existing right, and lessening the almost prohibitory expenses now necessarily incurred by inventors in obtaining such right, similar in a great degree to those which we and many others have from time to time endeavoured to enforce, and which, we trust, ere long will obtain due attention from the legislature.

As regards the inventors, copyright in design has much to be said in its favour, perhaps to a greater extent than patent right, which, for want of some word of more distinguishable significance, is in the books held to apply to "useful inventions;" for who can deny that that which is calculated to cultivate the imagination, by elevating the taste, ought to receive the greatest possible encouragement, when it may be no less true, but not, indeed, so obvious, that the pleasure of ministering to utility should form a principal portion of the reward attending the labours of the inventive mind? But the line has yet to be drawn between registration right and patent right—between a matter which should be simply registered, and one for which a patent should be obtained. They only who are largely concerned in exercising their judgment in this respect, know how difficult it is to arrive at a satisfactory determination in many particular cases. And we are inclined to believe that, if some such line as that we have above suggested were drawn, it would confine both within their proper bounds, and, with other improvements, to which we may shortly have occasion to advert, place this intricate subject in a proper and reasonable position. Let every new invention which appeals to *taste* be registered simply, and that which appeals to the judgment, in the more ostensible form of utility—*greater production in a given time*—be patented.

As to time for the exercise of the right, Mr. Turner has the following observations:—

> "If any fixed term, three months, three years, &c., be appointed, it must be needlessly long for one design and unjustly short for another, and, of course, the most deserving will suffer most. This topic has been amply discussed in literature. In patents, the injustice was so glaring, that various private acts were passed from time to time in favour of individuals, and subsequently the capability of prolongation was adopted as a principle, and committed to appropriate ministers. The tardier maturity and prolonged bearing of the crop in patterns of a superior value in the same art, was particularly brought forward in the evidence on calico. Measuring the term by the life of the author, or even of his widow, is quite indefeasible; it is a relic of barbarism. The accidental value of a man's life cannot possibly affect the value of his works to society, nor the cost of the headwork spent upon them, except merely in one point of view, that the work of a veteran, the rich results of accumulated intellectual wealth, meet with the worst remuneration. A man knows that, as his powers become worth more to society, they are worth less to himself and his family; and the inventor or artist, in those pursuits which, by mechanical reproduction, increase the happiness of all, is alone deprived of that stimulus which, in all other professions, encourage the student to strive unceasingly for perfection. Assuming thirty-six as an average age of maximum intellectual production, the twenty-eight years of an engraver would, perhaps, nearly agree with a life interest, and the sculptor would, in the majority of cases, get his contingent fourteen years, and the right of the chisel would last as long as that of the graver. In manufacture design, the point of duration of

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[*] Report of Committee and Brit. Mus. 1835, p. 384.

[†] I may as well mention that all the dimensions quoted here are taken from the plan published with the report of the Committee in 1838: the dimensions of the floors being generally figured on the plan and reference to scale, there can be no mistake about them, nor as to the height of the principal floor; the height of the closet, however, and of other subordinate apartments, are only approximations; but where such is the case, I have always tried to allow an excess.

[‡] Report of Committee and Brit. Mus. 1838, p. 11

life does not occur, the right going at once to the proprietor. Whatever hankering may have existed after the perpetuity of the ante-statutory right, it is satisfactory to see that any alterations that have occurred in the latter acts, relative to any kind of copyright, have had the sign of plus prefixed; and the extensionists have hitherto had all the argument, much of the public sympathy, and a little of the success, and there is every prospect that this will hold good for the future also."

We make room for one more extract upon the policy of the party owning the invention availing himself of the right.

"A painter needs no registration, his work is inimitable; and, while in his keeping, there are no mechanical modes of copying without long and elaborate processes; nor would it be easy to steal a cast of a statue. The number of probable copies require notice; if few, it will be the less worth while to incur the expense of the mould or plate. If the demand be occasional only, the copyright will expire too long before the value of the article; but the copyright for a short period may, during that time, give a firm hold of the market, and the articles must not, during the existence of the right, be even begun to be made. When the public cannot verify, but must buy on the good faith of the maker, his name and tradesmark (which are legally protected) may confine the trade to the inventor. If the demand be likely to be very transient, the first starter may pour into the market all that it will hold, and leave only a few stray gleanings. If the number of absolute copies, as of a book, allow of stereotyping, this will bid defiance to piracy; and when the article varies much in its application, it will involve more difficulty to claim the identity of form; but it will also, by leaving more to skilful adaptation in each peculiar case, make the subject more independent of copyright. In proportion as the number of copies increases, not only does the necessity for protection increase, but its cost decreases; a million copies of a registration pay no more than one. Registration is often only one of the innumerable contrivances for puffing; it may, however, be sometimes almost necessary to adopt registration, or subject the article to the suspicion on the part of the public of its not being worth it. On some points there is a choice as to the mode of protection, but the rules warn the registerer that the nature and extent of the rights conferred are left to his own judgment and discretion; and care must be taken to choose well in the first instance. Any registration publishes the design, and is irreparable. A map may be claimed as a book, or left to its fate as a print; and useful invention is in some cases patentable or registrable. In this case the term must be carefully considered, and the cost and value of the subject, and the probability of an extension of registration law may perhaps be an element in the calculation. One of the registered designs was for "a right-angled beam steam-engine," which, if worth anything, was worth a patent. It may sometimes be advisable to register a design in two or three classes, to prevent a shawl pattern from being 'vulgarized,' by using it for calico, carpet, or paper."

Gas-Lighting: its Progress and its Prospects; with Remarks on the Rating of Gas-Mains, and a Note on the Electric-Light. By J. O. N. Rutter, F.R.A.S. Pp. 64. London: Parker, West Strand. 1849.

Mr. Rutter has done much for gas-lighting, not alone in his position as the directing head of the Brighton works, but also, and in a far wider sense, as an indefatigable writer on the subject, which has never been more ably treated of than under his hands. Of his miniature production, "The Advantages of Gas-Light in Private Houses," 60,000 or 70,000 copies have been circulated—it has penetrated to all quarters, and has been read by every one,—for it contains the essence of so much practical information as the user of gas-light ought to possess. The work before us, whilst we doubt whether it can be more useful, has higher pretensions; it gives us both an exposition of the progress, and a well-digested opinion of the prospects of this system of lighting. From its introductory page we quote the following:—

"Nearly sixty years ago a gentleman, then residing at Redruth, in Cornwall, used to amuse himself, and astonish his neighbours, by riding about in a little steam-carriage, which, at night, was lighted by means of bladders filled with coal-gas. Although nothing is known of the step-by-step process by which Mr. Murdoch attained his objects, we may be sure that he must have tried a great number of experiments. Viewed from this distance, with the advantages possessed by the after-thoughts and experiences of so long a period, the disappointments and successes of the inventor of gas-lighting would be more curious than instructive. The merits of an inventor are distinct from those of an immediate imitator. The latter applies, and frequently improves upon, the work of his predecessor. But they still occupy separate spheres, difficult as it is to assign to each his proper place. Both deserve, and ought to receive, not honour only, but more substantial rewards. Yet the little germ of thought which first sets the hands to work—the first rough and awkward attempt to do a thing which was never done, or not known to have been done, before, has a freshness about it which imparts to it an interest peculiarly its own. Measured by the standard of practical utility, the imitator, whether immediate or remote, is sometimes in reality more of an inventor than the man to whom that honour exclusively belongs; and it is the practical man who generally reaps the largest reward. With that he should be content; not forfeiting his claim to a fair proportion also of honour, by attempting to conceal, or unjustly to appropriate, that which belongs only to another.

"The inventor of gas-lighting has had many imitators, and but few detractors. Many have profited by his experiments in simplifying and improving upon his processes. But although so many minds, and so many hands, have been kept at work, since Mr. Murdoch's steam-carriage and his house and offices were lighted with gas (in 1792), the science which he thus originated has not even now attained to the degree of perfection of which it is susceptible. Extensive as are the operations of gas-lighting, and incalculable as are its benefits to society, its advantages are not yet half understood, and, consequently, are not sufficiently diffused.

"Many mistakes have been made, vast sums of money wasted, and years of energy, and skill, and toil, have gone unrewarded. This is one of the evils attendant upon a new invention, especially when it happens to be one of general application, and on which many persons can be engaged, independently of each other, at the same time. It would, perhaps, be impossible to quote an instance within the same period, and of similar extent in its operations, in which so much ignorance of commercial enterprise has been exhibited, so much empiricism practised, and so much money misapplied as in gas-lighting. In its earlier days men set themselves up for engineers who were totally unfit for their office, because profoundly ignorant of the work they undertook to perform. Under such guidance, companies were hastily established, contracts were entered into, works were almost as quickly erected, and towns were lighted. For a time everything looked cheering; but success was of brief duration. Then followed conflicts, and disputes, and losses, and disappointments, known only to those who have been concerned in them, and have had to fight their way through them. In some favoured localities, notwithstanding excessive expenditure, and losing contracts, and in spite of a long continuance of bad management, companies have realized fair, and a few of tham large, profits. These are fortunate exceptions. In the greater number of instances the results, for some years, were far otherwise."

We have afterwards some pertinent remarks upon the erroneous street-lamp system, which we commend to the consideration of all public authorities.

Another point of importance in the book, is that which relates to the burning of gas by contract for time, in place of quantity. From the comparative non-prevalence of this course, in this neighbourhood, it may not appear to demand such especial attention as Mr. Rutter has accorded to it, but in the south the case is different:—

"Now let me refer to another error—a cause of many disputes, and of much dissatisfaction—of accusations of fraud, and recriminations of oppression—that have been discreditable to all the parties concerned in them. This was the contract system—that is, burning gas by time instead of measure. It has not been so extensively adopted as the street-lamp system; but wherever it has existed, it has operated in precisely the same manner in keeping up prices. How could it be expected that it should be otherwise? What more effective plan could have been invented for encouraging waste, for setting people to devising methods of burning gas surreptitiously, and thus offering the most powerful temptation for breaking down every feeling of moral obligation between buyer and seller? The charge per burner was made upon an estimated rate of consumption per hour, certain conditions being stipulated as to the size and form of the burner, the dimensions of the flame, and the number of hours it should be used. Nothing could be more easy, nothing was more common, than the violation of such conditions. To compensate for the loss thus sustained, the companies charged the gas so supplied at a proportionately higher rate. Here was a plain recognition of waste and fraud, as among the principal conditions of the agreement; and as plain an intimation as could be given, that the careful and honest consumer must pay for the neglect, extravagance, or theft, of his neighbour. In the metropolis, and some large provincial towns, where competition has for many years existed, it is quite within the mark to say that, in hundreds of instances, there have been persons supplied with gas at one-fourth the price ordinarily paid by others. Whatever might be the nominal price charged to contract consumers, and the actual price paid by meter consumers, it is evident that the latter contribute most in proportion to the profits and permanent success of the company. These pay for all the gas they consume, using, in fact, their own property. The contract consumers use the property of the company, paying a fixed price, and taking as much gas as they please. How truly absurd would such an arrangement be considered, if applied to any other business! Think of a brewer, or a wine-merchant, a baker, or a butcher, contracting with his customers, according to the number of persons in their families, and allowing them to help themselves!"

In the delineation of his notions of the prospects of gas-lighting, our author writes with a cheering pen; he looks upon the present "discussion and inquiry" system as calculated, in the end, to produce a better feeling; and this brings us to a short chapter on the electric light, which, as the would-be antagonist of gas, here meets with some little consideration. The chapter in question has so much to recommend it in many ways, that we shall quote it entire, as a finish to this brief notice of a production worthy of universal perusal.

"This is not a new invention. As one of the means of illustrating the powers of voltaic electricity, resulting from the discoveries in that branch of science by Sir Humphrey Davy, the voltaic light, evolved between charcoal points, has, from that time to the present, been familiarly associated with the operations in the laboratory and the lecture-room, both by amateurs and professors. Nor is its recent exhibition in London the 'first appearance' of the light in public. About six years since it was shown in the streets of Paris, where, for a short time, it excited as much attention as it has lately done in this country. As a philosophical experiment, and especially when seen for the first time, the electric light is as startling as it is beautiful. Those who have never witnessed its effects are unable to form any correct opinion on the subject. Its intense brilliancy, and the consequent depth, or rather darkness, of the shadows, surpass all the ordinary phenomena of artificial illumination. For a moment, the observer seems to be deprived of the power of vision. To look *at* the light, excepting from a distance, is extremely painful, and to be *in* it, produces sensations which, at first, are anything but agreeable.

"Many things are philosophically possible which are commercially impracticable. Sometimes, however, the difficulties are of another kind; arising not from cost of materials, but the skill required, and the time employed in the use of them. Inventions which, in our own day, have excited the brightest hopes, and which, if a hundredth part of what was said of them had been realized, would, in some sense, have turned the world upside down, have passed away, and are forgotten, or are used only as philosophical toys. There is nothing disheartening in this. Mistakes can be easily accounted for. Inventors never profit by the failures, whilst they are often ruined by the successes, of others.[*]

"Whether the electric-light will ever be so complete, both in its mechanical and voltaic arrangements, as to be of any practical utility, or whether it will remain, as at present, a wonderful illustration of electrical agencies, and nothing further, are questions which must be left for futurity to answer. The man is more bold than wise, and proves himself no safe guide in such matters, who ventures to solve either of them now. That which appears impossible to-day, might, perhaps, be easily accomplished to-morrow. The annals of science, and of invention, are crowded with examples in which one happy thought, one simple condition, one little lever, or wheel, or pinion, has finished, and crowned with success, the labours (with its attendant losses and disappointments) of many years. But we must look also on the other side; and there are found discoveries, and inventions, and machines, without number, which, for want of a happy thought, a required condition, a lever, or wheel, or pinion, in the right place, still remain unfinished.

"In the mechanism of the electric-light some improvements have been made. In other respects the progress is remarkably slow. Patent after patent has been granted; years of labour and large sums of money have been expended; but, as respects real usefulness, nothing seems to have been accomplished. A light of dazzling brilliancy can be shown for a few minutes at a time. Sir Humphrey Davy did this; and hundreds of others, some for amusement, some for instruction, have done the same. Steadiness and continuity are qualities essential to all methods of artificial illumination. In each of these qualities the electric-light is deficient. If it be so cheap, that light equal to one hundred candles costs only one penny per hour, if it be so easily managed that it can be as readily adapted in lighting a private house as the most extensive building, and whether the light required be equal to 10, or 100, or 100,000 candles, might it not have been expected, that privately, or in public, at least one specimen of the light would have been kept in action for a few hours every night to have demonstrated its capabilities?

"Those who understand the details of the process, do not wonder that the electric-light is intermitting and uncertain. To maintain, at a high intensity, an uniform power in a voltaic battery, is sufficiently difficult; to adjust the carbon points, even by the aid of the most ably-constructed machinery, is apparently impossible. Increase or diminution of power in the battery renders necessary a new adjustment of the carbon. Differences in the quality of the latter, or the admixture of impurities, also interfere with the success of the operations. Machinery, however sensitive, cannot adapt itself to these constantly varying conditions. It may be perfect in its motions, and exact in its graduations, but still it cannot *think* about its work, or *know* what it has to do; and hence, in this instance, it fails in performing all that is required. At one period of the process the carbon point may probably be required to move at the rate of 1-100th of an inch in a certain time, at another the required rate may be 1-1000th, or 1-10,000th, of an inch in the same time. Herein consists some of the practical difficulties. These are only a small part of them.

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[*] "'The identical mechanism, that has broken down a dozen times in other hands, is once more made the subject of new patents, by men who are not only ignorant of the simple scientific principles which would have taught them their folly, but who do not know the fact that the selfsame ideas have long since been worked out and abandoned.'" —*Edinburgh Review*, No clxxix. p. 47.

"As respects cost, nothing at present need be said. It will be time enough to discuss the economy of the process when all other objections, and especially those of manipulation, are cleared away. If electric power could be obtained without cost, that would not aid the invention. The causes of failure are more recondite than the prices of acids and of metals. In the present state of our knowledge, and notwithstanding all the so-called recent improvements, the electric-light remains, what it has hitherto been, a very impressive, and very brilliant philosophical experiment, and nothing more."

CORRESPONDENCE.

ON PROPERTY IN INVENTIONS.

It is not the general character of the laws of the United Kingdom to exhibit an indifference to the protection of wealth; but in that kind of property which is the result of science, the usual watchful care, which is perhaps almost too characteristic of our laws, appears to have been forgotten.

In the instance of literary property, this is by no means the case; whether resulting from the greater ability possessed by authors in making their requirements known to the public, or from the greater sympathy of a legislature, consisting partly of literary men, is uncertain; but the fact is patent, that no kind of property is protected so efficiently, and at so little expense, as the property of authors in their works.

I presume it is hardly needful to recall to the memory of our readers, that the social reason for the protection of property is, that wealth may be produced and saved; and that on the production and accumulation of wealth depends the progress of civilization. These undisputed truths are the common property of mankind; and were it not that mankind at large, and especially that portion which performs the legislative work of society, have not had their attention directed to the evils which result from the very imperfect protection of property in scientific designs, afforded by the present state of the law, the property of inventors in their designs would, long ere this, have been protected as efficiently as the property of authors.

Having said "imperfect protection afforded by the present state of the law," I now proceed to justify that saying. There are only two modes of protecting inventions—viz., registration and patents. The first is for so short a period, 3 years, that it hardly affords time for the requisite experiments to determine the value of a new invention; certainly, in many instances, not time to make the invention known and adopted to a sufficient extent to remunerate the inventor of a new machine or process. Patents are not open to the objection of the protection being for a very short time. Fourteen years is a sufficient period to afford the inventor of most good things a reasonable chance of being repaid for his labour in producing what is useful to society; besides, the period may be extended, on sufficient cause being shown;—but there is one condition required, which, in a majority of instances, renders a patent of no avail for protecting inventions, which is the enormous property qualification required in the patentee. A hundred and thirty pounds is a sum as far beyond the means of the majority of inventors—who are not a rich class—as would be a requirement to pay the national debt. Consequently, for one invention made patent, perhaps a hundred are concealed, and society never feels the benefit of them.

At first sight, it might appear doubtful to a person in the habit of reading the long lists of new patents and registrations, that any designs are concealed, and certainly, for the reputation of the inventors, many had better not have been published; but I can vouch that a considerable number, which have been communicated to me in confidence, are now unpublished, and if one individual is acquainted with many, the total number concealed is likely to be enormous.

It is probable that society never inflicts an injury on any of its members, but that injury recoils on itself. In the instance of neglecting to protect the property of inventors, the injury to them is avenged on society by the absence of the social comforts which would result from the use of the many hidden inventions; but as we never miss what we never possessed, we are no more sensible of these deficiencies than an uneducated person of the pleasures of science and literature.

As it has been justly remarked, that pointing out evils is only half-rectifying them, and as grumblingwithout suggesting improvements is not a very gratifying occupation, I may, perhaps, offer a suggestion for the remedy.

As it is found that the copyright of books is secured for the smallest possible cost by the existing law, I would recommend that a similar copyright of scientific designs should be obtained by simply registering, in a public office, the fact that A.B. has designed a new machine, or discovered a new process.—Of course it would be needful, then as now, to deposit drawings and a specification of the invention for public inspection; but I know no reason why the inventor should be charged more for registering the birth of this child of his brain, than he is charged for registering the birth of his son, which he can do gratis, although in both instances the maintainance of them afterwards is apt to be expensive.

Perhaps inventions might be classed, some to be protected, for a short period, some for seven years, some for fourteen, or in particular instances for longer periods—but this is matter of detail. What I do contend for is, that, as we all pay our share of the expenses of police and civil government, we are morally entitled to have our property protected, whether that property is in the form of inventions, or of the wealth produced by the use of inventions.

It has been objected, that if patents were not more costly than the routine securing the copyright of books, we might be annoyed by as large a proportion of absurd inventions, as we are by the many bad books which issue from the press. I fear this is partly true, but, I much doubt, if the proportion of absurdities would be greater than it is at present. Whoever has been in the habit of reading specifications, must remember that the absurdities now bear a large proportion to the total number; and when it is considered that the class of inventors who combine practical with theoretical knowledge—viz., the more intelligent of the operatives—would be then able to patent their inventions at a small expense, I cannot but opine that if the total number of useless absurdities were greater than at present, the proportion of them would be less than it now is, when the only qualification required in patenting one is a property which does not necessarily include scientific acquirements.

It may also be objected that, as the present system of fees is attended with the advantage of greatly increasing the income of the officials, it would be an evil to them to alter it. This is undeniable; but it would be far more economical to give compensation to those who gain by this private and public wrong, than to allow individuals to accumulate wealth at the expense of that class—*i.e.* inventors—who have, in the words of the French philosopher, "made good things cheap," and, what is much worse, thereby prevent the publication of inventions, which would make the good things of this world yet cheaper, and consequently obtainable by those classes of society which, under the present system, are debarred from using them.

Alfred Savage, Machinist.

43, *Eastcheap*, *London*.

REFRIGERATING BRASSES.

With reference to the paragraph in your Journal for last month, headed "Brunet's Refrigerating Brasses," I beg to state, for the information of your readers, that the application of cold water in the way therein described, to prevent the heating of brasses, is a patented invention.

In December 1846, letters patent were granted to Mr. John Blyth of Limehouse, London, for "Improvements for diminishing the risk of accidental explosions of gunpowder," and one of the improvements described in Mr. Blyth's specification, is the application of cold water to hollow bearing brasses. The use of the improvement is claimed for all purposes of machinery and millwork. G.

London, 18*th August*, 1849.

[We find that Mr. Blyth obtained a patent in December 1845—not 1846, as stated by our correspondent. Its title is—"Certain improvements in diminishing the risk of accidental explosions of gunpowder and other substances, which are liable to explode or ignite by contact with fire." As we have not yet had an opportunity of examining the specification, we are unable to add our testimony either in favour of or against his observations. The point of the invention, however, as applied by Mr. Brunet, appears to have very little connection with the title we have quoted.—Ed. P. M. J.]

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF MECHANICAL ENGINEERS.

The General Meeting of the Members of this energetic Association, was held at Birmingham, on the 25th of July last, Charles Beyer, Esq., Vice-President, in the Chair. In addition to the general business of the meeting, four papers on various subjects were read. The first, by Mr. Ramsbottom of Manchester, "On an improved Locomotive Boiler;" the second, by Mr. Benjamin Gibbons, "On a Pneumatic Lift;" the third, by Mr. Fairbairn of Manchester, "On the Expansive Action of Steam, and a New Construction of Expansion Valves for Condensing Steam-Engines;" and the fourth, by Mr. David Burn of Newcastle, "On the System of Ventilation in the Wallsend Colliery." This is an interesting bill of fare, which we shall proceed to illustrate by an abstract of Mr. Ramsbottom's account of his improved boiler—

It is scarcely necessary to observe that the absolute power of a locomotive, or any other steam-engine, is strictly proportioned to the quantity of steam which the boiler of such engine can produce in a given time; and chemists are generally agreed that the quantity of atmospheric air required, (or oxygen, which is the supporter of combustion), as well as the quantity of fuel, is in direct proportion to the quantity of water evaporated; or in other words, to produce more steam, it is not only necessary to supply more fuel, but also more atmospheric air, in proportion to the quantity of steam produced.

It is well known that some of the locomotive engines built at the present day have from two to three times as much heating surface as those built about eight or ten years ago, and consequently, when performing a proportionately increased amount of duty, they require from two to three times the quantity of air forcing through the fire in the same time.

The working parts of these engines have also been increased in dimensions; the cylinders from 12 inches to 15 and 16 inches diameter, the stroke from 16 inches to 20 and 24 inches, and the driving wheels from 4 feet 6 inches to 6 feet diameter, and in many cases even more.

Notwithstanding all these enlargements and improvements, there are, however, two elements which have been but slightly changed; namely, *the diameter of the blast pipe*, and the diameter of the *cylindrical part of the boiler;* and as the whole of the steam (after having performed its office in the cylinders) is driven in a forcible jet up the chimney for the purpose of producing the necessary draught through the fire, and as the power required to produce this jet is so much taken from the gross power of the engine, it follows that the smaller the blast pipe is in proportion to the total heating surface of the boiler, the greater will be the resistance to the action of the piston, and the greater the loss of power on this account.

From observations made upon engines under the author's immediate superintendence, it appears that whilst the heating surface of locomotive boilers has been increased from 400 square feet (in the year 1842) to 987 square feet (in the year 1846), the blast pipe has not been in the slightest degree enlarged, but, on the contrary, in the latter case, has been reduced in area in the proportion of 12½ to 8¼ square inches. So that upon dividing the total heating surface or *area of production*, as it may be termed, by the size of the blast pipe, or *area of eduction*, (assumed as unity), the following very instructive results are obtained.

No. of Engine.	When built.	Area ot Blast Pipe	Heating Surface.
24	1842	1	4608
20	1842	1	5044
25	1845	1	7961
30	1846	1	12960

In the last case, then, it appears that the heating surface has been increased nearly *three-fold* in proportion to the size of the blast pipe, as compared with engine No. 24; and the reason will be obvious, when it is stated that the boiler No. 30 is only of the same diameter as the first named (No. 24), and consequently that the flue room, (which as a general rule will be as the square of the diameter of the boiler), has been but slightly increased, the extra heating surface having been mainly obtained by enlarging the fire-box, by putting in a mid-feather, and by increasing the length rather than the number of tubes.

It is not necessary to inquire how far the diameter of the cylinders may affect the size of the blast pipe, nor to ascertain the amount of power which the blast pipe absorbs, though it may be stated that experience proves it to range from 10 to 20 per cent. of the gross power of the engine, according to the number, diameter, and length of tubes, and also the speed of the engine. It may be remarked, however, that, on the average, a degree of exhaustion is required in the fire-box under ordinary circumstances equal to a column of water 4 inches in height, and the degree of exhaustion in the smoke-box must of course be greater than this by the resistance offered by the tubes to the passage of the heated gases from the fire-box to the smoke-box.

From experiments made about 2½ years ago upon an engine with a total heating surface of 987 feet, carrying 147 tubes of 1¾ inch external diameter and 13 feet 10 inches long, the author found that the latter force was at all velocities, *three times* as great as the former; or in other words, that 66 per cent. of the total force of the blast was required to overcome the resistance offered by the tubes to the passage of the heated gases, leaving 33 per cent. only to operate upon the fuel; and it is this evil, which results from the comparatively limited flue area of the boilers as at present constructed, to which attention is now more particularly called, and which it is proposed to remedy in the manner now to be explained.

From what has been said, it will readily be inferred that there is some difficulty in materially increasing the power of locomotive engines, as the necessary amount of heating surface cannot be obtained without increasing the diameter or the length of the boiler, or making it oval, to all of which plans there are some objections; but by the method now proposed it will be easy to enlarge both the fire-box and tube surface from 35 to 40 per cent., without increasing either the diameter of the boiler or its length, as will be now shown.

It is proposed to construct the copper fire-box with an arched roof, the top of which shall be nearly as high as the top of the cylindrical part of the boiler. This box may of course be made any length without sensibly reducing the strength of the roof, and will require none of the stay-bars which are so essential to the security of the flat-roofed box, and which, for a moderate sized engine, weigh not less than 400 lbs.

With such a box the whole of the cylindrical part of the boiler can be filled with tubes, and of course the whole of the longitudinal stays be removed; and in the present instance there are 225 tubes of 2 inches external diameter, the shell of the boiler being 3 feet 8 inches diameter and 10 feet long; the total heating surface of the fire-box is 80 feet, and of the tubes 1177 feet, making a total heating surface of 1257 feet.

Such an arrangement involves the necessity of keeping the boiler full of water, and it is therefore requisite that a separate steam chamber should be provided. This consists of a cylinder which is 13 feet long and 20 inches diameter, fixed over and parallel to the cylindrical part of the boiler, or, as it may now be termed, the generator. This tube, which has a cubic capacity of 28⅓ feet, is connected at each end with the generator. It is proposed that the water shall occupy about one-fourth of the capacity of this tube, leaving a clear space, say, of 21 cubic feet for steam; this is rather more steam-room than most modern boilers possess, and for reasons which are afterwards mentioned, the author thinks it will be sufficient, although it may readily be increased by slightly enlarging the diameter of the steam chamber, which, as at present shown, is not so high as the ordinary steam dome by about 12 inches.

It has been proved experimentally by Mr. Robert Stephenson that the generative power of the copper fire-box is three times as great per unit of surface as that of the tubes; and independent of this authority, locomotive engineers are generally agreed that the great bulk of the steam generated in a locomotive boiler is formed upon the surface of the copper fire-box and the first 18 or 20 inches length of the tubes. As the whole of the steam has to rise through the body of the water, with which it is for the time mechanically mixed, and as the specific gravity of these mixed fluids will be much less than the comparatively *un*mixed water at the smoke-box end of the boiler, it follows that there will be a brisk circulation through the generator and steam-chamber. The mixed steam and water will be driven into the upper vessel, and will there be effectually separated; the former passing off to the cylinders by a longitudinal pipe, which has a number of small holes upon its upper surface, and the latter running again into the generator through the vertical connection at the front end, and thus keeping up the circulation.

That the specific gravity of the mixed steam and water at the fire-box end is often reduced to at least one-half that of water alone, is proved by the fact that the water guage will frequently show a downward current through the glass tube, even though the circulating fluids be one-half water and one-half steam, showing as it does that the column of the mixed fluids in the boiler is specifically lighter than the column in the glass guage; and from this fact it is also evident that this great expansion is confined to the water in the vicinity of the fire-box, since, if it extended to the whole mass, the boiler would not contain the requisite quantity.

From the circumstance that no bubble of steam can rise into the steam-chamber, it is concluded that this boiler will not be so liable to prime as the common one, and therefore that the steam-chamber as shown is sufficiently large. As to the water surface, which in this boiler it may be objected is smaller than in others, it is conceived that the great facilities this boiler will give to the engineer for raising steam, will leave him comparatively at liberty to put in water when and where he chooses, and consequently that but little difficulty need be apprehended on this point. It is evident, however, that the objection may be fully met by constructing the outer fire-box with a pyramidical roof in the way so common.

In conclusion, the author would express his conviction that this boiler, combining, as it does, a great increase of heating surface, *and corresponding increase of flue area*, with a relative diminution of bulk and weight, and great simplicity of construction, is calculated to remove some of the difficulties experienced by locomotive engineers, and to promote the best interests of the railway world in general.

The Chairman said that, in the unavoidable absence of Mr. Ramsbottom, he would observe that his object in the foregoing paper was to obtain a considerably larger area of flue-room than in the present locomotive boilers, and to make a boiler of a large heating-surface with less weight.

Mr. Slate and Mr. Cowper both urged the presumed liability of such a boiler to prime; but Mr. M'Connell thought this might be obviated by certain modifications, which would leave the main point of an increased amount of direct heating-surface untouched. He further remarked, that a very considerable amount was lost at the end of the longest tubes; and thought that the air in the centre of the tubes might have a considerably higher temperature than that at the sides, and that much of the heat might be carried through by a stream of air like a solid bar in the centre of each tube, without giving off much to the water.—Mr. Gibbons stated that the pipes used for heating the air in his blast furnaces, near Dudley, were bent like a syphon, and a considerable gain resulted from bringing the particles of the air more directly in contact with the sides.—Mr. Allan had tried an engine with a ½-inch rod of iron fixed in the centre of each tube; the rods were as long as the tubes, and were supported at intervals by short pins. After a lengthened working test, no difference was found as compared with open tubes.

The Chairman said, he was present when the experiments were tried, that were mentioned by Mr. Ramsbottom, to ascertain the difference between the degree of exhaustion in the smoke-box and in the fire-box; the experiments were tried with a long boiler engine, and a glass water guage fitted into the smoke-box and another into the fire-box. The degree of exhaustion in the smoke-box averaged three times as great as that in the fire-box, and this proportion was found to be nearly the same at all velocities; the greatest amount of exhaustion observed in the smoke-box supported a column of water 13 inches high. He thought that the whole resistance of the blast-pipe, and the back pressure in the cylinder, did not amount to more than 15 per cent. of the power of the engine. He considered that none of the various proposed modifications of boilers promised to be so useful as the one under notice.

SOCIETY OF ARTS.

Since our last notes of the proceedings of this Society, the 95th Sessional Meeting has taken place, when the prizes and awards for inventions and designs, contributed during the past year, were distributed. Prince Albert occupied the chair. In the section of Chemistry we are glad to see the name of our valuable correspondent, Mr. R. Smith of Blackford, who has received a silver medal for his method of printing and lustering china and earthenware, described by us at page 3 of our present volume.

In the Section of Trade and Manufactures.—To Mr. J. A. Leon, for his paper on the Cultivation and Manufacture of Sugar, the large gold medal presented by his Royal Highness the Prince Albert. To Dr. Mitchell, for his Essay on Improved Processes in the Manufacture of Sugar, the gold Isis medal. To Mr. Littledale, for his Essay on the Processes in the Manufacture of Sugar in the Colonies, the large silver medal. To Mr. Wray, in acknowledgment of the merit of his printed work on the Manufacture of Sugar, the large silver medal. To Mr. James Johnson, for a sample of Cashmere wool, and his efforts to introduce the culture of the same in New South Wales, the large silver medal.

The second of these gentlemen had competed with the first for the medal of his Royal Highness; but as his process had not been put in practice, it had been awarded to Mr. Leon.

Earl Grey received the medal intended for Dr. Mitchell, and took the opportunity of expressing his sense of the importance of the subject upon which these essays had been written. He should have great pleasure in transmitting the medal to Lord Harris, the Governor of Trinidad, who would deliver it to Dr. Mitchell. The noble earl also took charge, for a similar purpose, of two other medals, the competitors for which were also colonists.

In the Section of Fine Arts and Manufactures those prizes which are more worthy of notice are the following:—

To Mr. W. B. Simpson, for his paper decorations and efforts to promote the improvement of designs in paper hangings.

The gold Isis medal to Mr. J. A. Hatfield, for the improved character of his bronzes, especially the "Dying Gladiator."

The gold Isis medal to the Coalbrookdale Iron Company, for the superiority of their iron castings.

The gold Isis medal to Mr. J. F. Christy, for his specimen of printing on glass with enamelled colours.

The large silver medal to Messrs. Garrard, for their group in Florentine bronze of St. George and the Dragon.

The honorary testimonial to Messrs. Warner and Sons, for their improved designs in tea-urns.

The honorary testimonial to Messrs. Watson and Bell, for their specimens of carpets.

To Miss Stanley, for her exertions in establishing schools for instructing the children of the poor in the manufacture of lace in Norwich, the honorary testimonial and £5, with a request that she will distribute the £5 among the children of her school.

The Bishop of Norwich received the testimonial and draft on behalf of his daughter, and in returning thanks for the honour conferred upon her by the society, said he should not have ventured to interrupt the business of the day by any observations of his own, had it not been that, out of a long list of rewards, this was the only one which was in any degree related to the moral machinery of the poorer classes. If his daughter had derived any pleasure from the work of benevolence in which she had been engaged, it was more than equalled, no doubt, by the poor objects of her instruction, who, by being thus taught a trade, were rescued from the temptations incidental to their situation in life, and put in a fair way of achieving for themselves, if not an elevated place in society, at least a comfortable and honest one.

In the Section of Chemistry.—To Mr. R. Smith, for his method of printing and lustering on china and earthenware by means of electricity, the large silver medal. To Dr. E. Doeckman, for his specimen of scarlet on china, the large silver medal. To Dr. Fowlis, for his tangible ink for the blind, the large silver medal.

BRITISH ASSOCIATION.

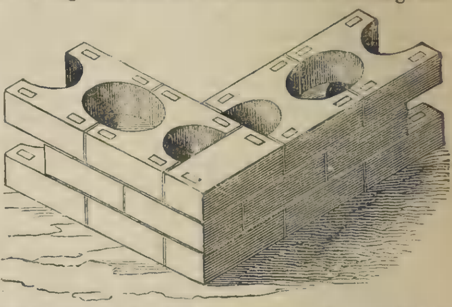
The forthcoming gathering of the members of this Association, at Birmingham, promises well. One great attraction will be the exhibition of works of art and manufacture, and models of machinery, which is to open with great effect on the 3d inst. A splendid exhibition-room has been fitted up in Bond Street, having an area of 2000 square feet. To the Governors of the Free Grammar-School the Association are also indebted for their use of the rooms. We may remind our readers that the meeting opens on the 12th inst. Full reports of all that is interesting will appear in the next and the succeeding numbers of this Journal.

MONTHLY NOTES.

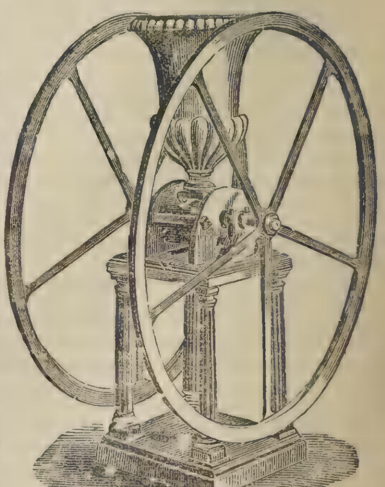
Crichton's Brooch Protector.—A clever contrivance for securing brooches when pinned in the dress has recently been registered by Mr. Crichton, jeweller, of 63 North Bridge, Edinburgh. It is applicable to any pattern of ornament, and consists in the addition of two separate smaller brooches, with attaching pins, to each of which is attached a securing chain. On the back of the two smaller or fastening brooches, is a small metal tube, through which the chains are passed, the chain attached to the right hand brooch being passed through the tube of the left hand one, and *vice versa.* Both tubes have a slit at one end to allow of their being moved freely when the chains are straight or drawn out, as in the act of attaching the brooch; but when the ends hang down on each side like tassels, they fall into the slits, and retain the whole from movement. Thus no direct power can detach the brooch from its hold in the dress when the pins are once properly adjusted.

Thornton's Steam Escape.—During the cooking of meat or vegetables in ordinary pans or coppers, the steam escapes at the lid, which is frequently equal to the entire area of the pan, and does not permit of a free escape of the vapour. In some cases, the difficulty is attempted to be obviated by introducing a pipe at the back part of the top of the boiler; but this is by no means an effectual plan. In the arrangement now brought forward by Mr. Thornton, of 31 Great Carter Lane, London, the top of the pan is supposed to be divided into five equal parts—three for the front flap or lid, one part blank, and the remainder in a lid rising from the back of the pan. The chimney or flue covers one-fifth of the top of the pan, so that a pressure of steam inside the copper will elevate the back lid, and permit the steam to escape up the chimney; and this lid, having a balance-weight, becomes a safety-valve of the simplest description. A short time previous to the withdrawal of the contents of the pan, the back lid is to be raised to its full opening, and the front lid a few inches, when the vapour will at once escape directly up the flue. The apparatus has been approved of by the Board of Guardians of the City of London Union, and it is now being carried into effect at their new Union House, Bow Road, Mile-End.

Ventilating Bricks.—An ingenious plan for the ventilation of buildings has been contrived by Messrs. Beedle and Rodgers of Wokingham, Berks, wherein the bricks themselves are the agents of the ventilating principle. The sketch annexed is a perspective representation of a 9-inch wall, built with the ventilating bricks, a single common brick being used at the angle of each course. The entire brick is somewhat of the H shape, a semi-cylindrical aperture being made on each side, so that, when built up as shown, the central solid portion of one brick comes over the centre of the opening formed by the end junction of the two below, leaving on each side a clear open space for the passage of a current of air throughout the whole erection. By the peculiar form of the bricks, one-half the duty is saved upon them. They are 9 inches long, 9 inches wide, and 3 inches thick; and although they act as double bricks in the building, they are only subject to single duty. The number of ordinary bricks required for a rod of brickwork is 4,300, but of the new kind 2,150 only are used. If a valve is set in the wall, the whole of the vitiated air may be withdrawn from a room without any perceptible draught; and, in the case of hothouses, the enclosed area may be warmed by a current of air through their interstices, without involving the disagreeable feature of a chimney-shaft.

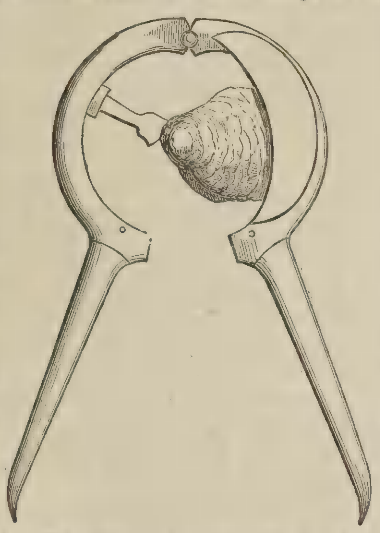


Ornamental Grinding-Mills.—The modern fashion of grocers' establishments runs in favour of the use of ornamental machinery as an attraction for the counter or the window, and this feeling has given rise to the production of a great variety of adornments of this class. Amongst the neatest things of the kind are the coffee grinding-mills made by Mr. Alfred Savage of Eastcheap, London. In the sketch of one of these mills, now given, the coffee is placed in a handsome vase, surmounting the shell of the grinding apparatus, which is carried on an entablature borne by four fluted columns, springing from a plain rectangular base-plate. The horizontal grinding-shaft runs in two external gun-metal bearings, set near the two edges of the entablature; and in this point a considerable improvement is effected, in the prevention of unequal wear on the grinding surfaces. The eccentric force of the fly-wheel in a hand-mill, very frequently causes excessive wear on the teeth, on the interior surface of the lower part of the exterior cone. It has also the disadvantage of causing the mill to grind finer at the bottom than at the top. In power-mills, the eccentric force of the driving strap produces the same result, which is quite obviated by the adoption of the plan of support we have mentioned.



Iron Houses.—Amongst the many results of the California rush is to be counted an extraordinary increase in the manufacture of old, and in the designing anew of such articles as offer to the eye of an emigrant advantages of portability, and facility in using. In this iron country, the staple material has always been largely employed in services of this nature—iron beds, iron tables, chairs, and all the range of articles for which wood alone was used, are produced from the more economical metal, and even iron houses on a large scale appear to be in demand. Messrs. M'Kean, Perkes, and Co., of Liverpool, in their capacities of contracting engineers, have contributed very largely to this show of novelties; and we have before us a drawing of a warehouse and dwelling-house conjoined, designed by them, the details of which seem admirably to adapt it for the use of the settler. It is an oblong erection, eight bays long, by four wide. The pilasters, which act as jambs for the doors, are of T-iron, their lower ends being bolted to a square foot-plate on the ground, whilst their tops are secured in pilaster-caps at the eaves. The ends of the rafters, which are also of T-iron, fit into and are supported by the caps. The main pilasters are formed of two plates or bars of iron, riveted to each other, with a short space between. The sides, ends, and roof, as also the doors, are of corrugated iron plates. In addition to this, we have been shown an elevation of a beautiful Gothic villa, also entirely of iron, the corrugated principle being freely introduced for the shell of the building, as well as for a bold verandah which runs along the front and ends. These houses are extremely simple in their arrangements for erection or removal, which may be accomplished in a few days by the most inexperienced persons. When galvanized, they reflect the heat, and are thus kept cool, and dampness is unknown in them.

Waygood's Corn Grinding and Dressing Mill.—This is an effective combination of apparatus for grinding and dressing grain, and apparently well suited for the use of emigrants and isolated families. The grinding surfaces are French burr, the upper stone being of great weight, so as to give the necessary pressure for softening the meal with as great an effect as a stone of greater diameter; and in this way the dead pressure, before considered necessary in small mills, is got rid of entirely. The stone-casing rests upon the top of an open frame, through which is passed the diagonal dresser, driven by a pulley on the vertical shaft of the mill. The ground material is supplied to it by a conducting tube, leading from the side of the casing to the head of the dressing cylinder. When required simply for bruising grain, the stones are set slightly under, and the dressing apparatus is detached.



The Paris Exposition—Picault's Oyster Opener.—Amongst the extensive collections of the products of industry, agriculture, and manufactures, of this year's exposition in Paris, is a peculiar mechanical contrivance in the shape of an oyster-opener, which we have engraved, to show how judiciously mechanical talent may be exercised in the improvement of articles of a humble class. The instrument, which is the invention of M. Picault, consists of two levers bent semicircularly at one end, and hinged together. In the curved portion of one of these levers is a narrow recess, of a size sufficient to receive the edge of an oyster as shown, and on the other lever, exactly opposite to this recess, is fixed an oblique knife, which, on drawing the two straight ends or handles of the levers together, enters the joint of the shells, and divides them at once. The cost of the instrument is about 5s.

Art in High Places.—The late affair of the royal etchings has afforded evidence of the Queen and her Consort's great love of art, not merely as admiring lookers-on, but as practical artists. Amongst other pursuits connected with her favourite amusement, her Majesty is at present collecting engravings from the many illustrious works of Edwin Landseer; and, amongst the rest, several examples of this master have found their way into the royal portfolio as split prints, from the hands of Mr. Baldwin, the inventor of the process. It appears that sheets of any size may be safely treated in this way.

Delineations of the Lathe Epicycloidal Curves.—We have been favoured by an amateur with a series of beautiful examples of epicycloidal curves, engraved in the lathe on copper with a diamond point. The figures produced are of endless variety, in which the greatest extremes of symmetry and irregularity are found. The greatest extent of interlineation is produced by a compound epicycloidal movement, one continuous line working into itself, so that no error can arise when the movement is once set. These figures have been produced by three other amateurs, quite independently, and by different means. The most symmetrical of the series are thus formed by an epicycloidal chuck, adapted to produce a spiral at the same time. The graceful beauty of some of these figures is quite marvellous, and leads us to suppose that they may be judiciously adopted in ornamental tracery for metal or ivory. In describing them, they are first traced out on paper, and when the required figure is attained, a diamond point is substituted, and they are at once engraved on copper from which to take impressions.

Tailors' Symmetrometer.—We should have supposed that the tailor's vocation would be one of the last to suffer from the encroachments of machinery; but if we are to judge from the many eccentric names appearing in the registration lists of the day, it would seem that modern invention is determined to transact some business with them. The point chiefly aimed at is the reduction of the present system of measurement of the body to a simple mechanical operation. Amongst the last attempts is that of Mr. Jones, of Duke Street, Liverpool, who has introduced a species of scale, whereby the shape for a coat is taken at once without the tediousness and uncertainty attending the existing plan of measurement. The instrument, which has received the name of "symmetrometer," is very ingenious; whether or not it will effect the desired end, remains to be proved by working test.

Reform of the Coinage—Florins.—By a royal proclamation, dated the 30th day of July, we perceive that the two-shilling silver pieces, or florins, so long talked of, are at once to be issued. They are of the old standard of fineness—namely, eleven ounces and two dwts. of fine silver, and eighteen dwts. of alloy, to the pound troy. The obverse bears the effigy of the Queen, crowned, with the inscription, "Victoria Regina," and the date; the reverse has the ensigns armorial of the United Kingdom, contained in four shields crosswise, each shield being surmounted by the royal crown, with the rose in the centre. In the compartments between the shields are the national emblems of the rose, thistle, and shamrock, surrounded by the words "One Florin, one-tenth of a Pound." The edges are milled. We suppose this is to be taken as an earnest of a coming thorough decimal coinage, so much wanted, although it appears to us that the introduction of one coin only of the decimal genus will simply have the effect of increasing confusion in pecuniary matters, without producing any corresponding benefit.

The Duchess of Argyle and Vesper Steamers.—The Duchess of Argyle, whose performances we have before noted, still retains her position as a fast and smooth-going river boat, and is a great favourite on her station between Glasgow and Garelochhead. Amongst her other rivals, the Vesper, a new boat, built and fitted by Mr. Wingate of White-inch, has recently come forward. The Vesper is a fine sharp model, and is propelled by a single steeple engine, in the old style of the Clyde boats. We had lately an opportunity of observing her try her speed against the Duchess, in crossing from Helensburgh to Greenock, and thence up the river to the Broomielaw. The two boats left Helensburgh quay at five in the evening, being fairly abreast at starting. The Duchess, however, soon drew away from her opponent, and eventually came into Greenock about two or three minutes before her, in the run of five miles, the distance being performed in twenty minutes. Again, in leaving Greenock, the Vesper got away first; but, after being twice called upon to slacken and give place to the Duchess, the latter passed her sometime before arriving at Port-Glasgow. Here the Duchess lost some time by stopping to land passengers, but she soon again reached and passed her competitor, and arrived at the Broomielaw very considerably ahead. The Vesper is a fast boat, so that it is a matter of considerable credit to the Duchess for having beaten her.

Erin's Queen.—Messrs. Thomson, of the Clyde-bank Foundry, have just completed a small pair of side-lever engines for a boat with this name. They present an example of very creditable workmanship, and are in some degree remarkable as being the first pair sent from the Clyde, with the double eccentric and link reversing motion. This movement is exactly similar to that now so generally adopted in locomotives. It possesses a great advantage, in giving to the engine-man a greater command over his engines than he can have by any other contrivance, as the reversing action is simple, instantaneous, and unbroken.

Steam-Boat Jealousy on the Clyde.—We are sorry to see, in a late paper, a letter of complaint from a passenger on board one of the river steamers, on the subject of the very reprehensible practice of racing on the river. It appears that on a recent occasion, when the complainant was passing down the river by the Mars, a Millport boat commanded by Capt. Mackenzie, a steamer was observed a-head, near Bowling, with a flag of defiance at her mast-head, and upon nearing her, she was found to be the Marquis of Stafford, a new boat built to ply between Glasgow and the Lewis, and considered somewhat of a crack vessel. Although her flag indicated a challenge for all and sundry to try their speed with her, the Mars speedily came up with her, and when near Port-Glasgow, attempted to pass her. According to the "rule of the road" on the river, whenever one boat overtakes another, the slower one must slacken her speed to let the other pass; but it appears that this regulation only holds good between Glasgow and Port-Glasgow, and below the latter place it is disregarded. The captain of the Marquis of Stafford took advantage of this, and completely jockeyed his competitor, by repeatedly crossing her bows whenever she came up; and, to avoid a collision, the faster vessel was obliged to submit to the indignity of being kept in the rear, as the channel at that part of the river is very narrow, and a very slight deviation from the true route would have sent her aground. We know the Marquis of Stafford to be a good and fast boat; but if, as in this case, a much older one can beat her in a fair run, it is, without remarking upon the danger which the passengers run in such a proceeding, highly disreputable on the part of the captain to act in the manner we have shown. The Marquis has only been a short time on her station, having been engine-fitted a few months ago, by Messrs. J. and G. Thomson of the Clyde-bank Foundry. She has a single direct-action engine, with feathering paddles; and, although beaten by a boat of much earlier date, she is deservedly considered to be by no means slow. Since this was written, the case has been carried before the River Bailie Court, and after several hearings, Captain Hudson of the Marquis of Stafford was fined £5 for breach of rules. It appears the Mars lost her figure-head and bowsprit in attempting to pass her competitor.

Furnaces for California.—The "Jane Dixon," just cleared out from Liverpool for San Francisco, has taken with her a number of the portable forges and smiths' hearths, made by Messrs. Chaplin and Dixon, of James Watt Street, in this city; being an order from a house in Liverpool, for dispatch to California. Some of the largest of the forges are fitted with fire-clay furnaces, as described by us in our former notice of the invention in vol. i., so that they may be used either simply as forges, or for the reduction of the precious metal of the diggings. We have no doubt but that they will be found very useful in the region for which they are intended.

Death of Mr. Perkins.—In a recent list of deaths appears the name of Mr. Jacob Perkins, the ingenious inventor of the method of transferring engravings on steel to steel plates, for bank notes. &c.; as also of the transfer of devices engraved on hardened steel rollers to the soft copper ones of the calico-printer, technically termed "milling." Mr. Perkins was an American by birth, but had resided in London for many years. His death took place on the 30th July, at the ripe age of 83.

ENGLISH PATENTS.

Sealed from 24*th July*, 1849, *to* 16*th August*, 1849.

Alexander Ferrier Rose, Greenvale-place, Glasgow, gentleman,—"A certain improvement, or certain improvements, in the process or operation of printing, and in the machinery or apparatus employed therein."—July 24th.

John Holt, Todmorden, Lancaster, manager of the Waterside Works,—"Improvements in machinery or apparatus for preparing cotton and other fibrous substances, parts of which improvements are applicable to machinery used in weighing."—24th.

Joseph Woods, Barge-yard Chambers, Bucklersbury,—"Improvements in bleaching certain organic substances, and in the manufacture of certain products therefrom."—(Being a communication.)—24th.

William Geeves, Battle-Bridge, Middlesex, saw-mill proprietor,—"Improvements in the manufacture of boxes for matches and other purposes."—31st.

Julien Edward Disbrowe Rodgers, High-street, Pimlico, professor of chemistry,—"Improvements in the manufacture of white lead."—31st.

David Harcourt, Birmingham, machinist,—"Improvements in vices, and in the manufacture of hinges, and also in apparatus for dressing and finishing articles made of metal."—31st.

Adam Yule, Dundee, master mariner, and John Chanter, of Lloyds, London, gentleman, —"Improvements in the preparation of materials for coating ships and other vessels."—31st.

Richard Kemsley Day, Hatford, Essex, hydrofuse manufacturer,—"Improvements in the manufacture of emery paper, emery cloth, and other scouring fabrics."—31st.

George Fellows Harrington, Portsmouth, dentist,—"Improvements in the manufacture of artificial teeth, and the beds and palates for teeth."—August 1st.

Florentin Joseph De Cavaillon, Paris, chemist,—"Certain improvements in obtaining carbonated hydrogen gas, and in applying the products resulting therefrom to various useful purposes."—1st.

Eugene Alexandre Desire Boucher, Rue des Vinaigriers, Paris, metal merchant,—"Certain improvements in the manufacture of cards."—1st.

Jerome Andre Drieu, Manchester, machinist,—"Certain improvements in the manufacture of wearing apparel, and in the machinery or apparatus connected therewith."—1st.

Benjamin Thompson, Newcastle-upon-Tyne, civil engineer,—"Improvements in the manufacture of iron."—1st.

Thomas Potts, Birmingham, manufacturer,—"Improvements in apparatus used with curtains, blinds, maps, and plans."—1st.

John Shaw, Glossop, Derby, musical instrument-maker,—"Certain improvements in air-guns."—1st.

Augustus Roehn, Paris, gentleman,—"Improvements in making roads and ways, and in covering the floors of court-yards, buildings, and other similar places."—(Being a communication.)—1st.

James Murdoch, Staple's Inn, mechanical draughtsman,—"Certain improvements in converting sea water into fresh, and in ventilating ships and other vessels; applicable also to the evaporation of liquids, and to the concentration and crystallization of syrups and saline solutions."—(Being a communication.)—1st.

John Parkinson, Bury, Lancaster, brass-founder,—"Improvements in machinery or apparatus for measuring and registering the flow of liquids."—1st.

Benjamin Aingworth, Birmingham, button-maker,—"Improvements in ornamenting iron and other metals for use in the manufacturing of gun-barrels, and all other articles to which the same ornamented metals may be applied."—1st.

David Clovis Knab, Leicester-place, civil engineer,—"An improved apparatus for distilling fatty and oily matters."—1st.

William Thomas, Cheapside, merchant, and John Marsh, foreman to the said Willia Thomas,—"Improvements in the manufacture of looped fabrics, stays, and other parts dress; also in apparatus for measuring."—9th.

Arthur Howe Holdsworth, of the *Beacon*, Dartmouth, Esq.,—"Improvements in the construction of marine boilers and funnels of steam-boats and vessels."—9th.

William Furness, Lawton-street, Liverpool, builder,—"Improvements in machinery for cutting, tenoning, planing, moulding, dovetailing, boring, mortising, tonging, grooving, and sawing wood; also for sharpening and grinding tools or surfaces, and also in welding steel to cast-iron."—9th.

John Knowlys, Heysham Tower, Lancaster, Esq.,—"Improvements in the application and combination of mineral and vegetable products, also in obtaining products from mineral and vegetable substances, and in the generation and application of heat."—9th.

Alfred Vincent Newton, Chancery-lane,—"Improvements in derricks for raising heavy bodies."—(Being a communication.)—9th.

John Ruthven, Edinburgh, civil engineer,—"Improvements in propelling and navigating ships, vessels, or boats, by steam or other powers."—(Being a communication.)—10th.

Arthur Dunn, Worcester, soap-maker,—"Improvements in making soap."—16th.

Frederick William Bochner, Paris, France, civil engineer,—"Certain improvements in machinery or apparatus for letter-press printing."—16th.

Richard Archibald Brooman, Fleet-street, London, patent agent,—"Improvements in machinery, apparatus, and processes for extracting, depurating, forming, drying, and evaporating substances."—(Being a communication.)—16th.

Jonathan Blake, Mount Pleasant, Eaton, Norwich, surgeon,—"Certain improvements in lamps."—16th.

James Young, Manchester, manufacturing chemist,—"Improvements in the treatment of certain ores and other matters containing metals, and in obtaining products therefrom."—16th.

Louis Lemaitre, late of Paris, now of the Hotel de l'Univers, Blackfriars, engineer,—"Improvements in the manufacture of ferules for fixing the tubes of locomotive and other boilers."—16th.

SCOTCH PATENTS.

Sealed from 21*st July*, 1849, *to* 22*d August*, 1849.

James White, Lambeth, Surrey, civil engineer,—"Improvements in machinery or apparatus for sowing seed."—July 25th.

James Green Gibson, Ardwick, near Manchester, Lancaster, machinist,—"Certain improvements in machines used for preparing to be spun, or spinning cotton and other fibrous substances, and for preparing to be woven and weaving such substances when spun."—30th.

Andrew Peddie How, United States, now residing at Basinghall-Street, London, engineer,—"An instrument or instruments for ascertaining the saltness of water in boilers."—(Communication.)—August 1st.

Hugh Lee Pattinson, Washington-house, Gateshead, Durham, chemical manufacturer, —"Improvements in manufacturing a certain compound or certain compounds of lead, and the application of a certain compound or certain compounds of lead to various useful purposes."—6th.

Amadée Francois Remond, Birmingham,—"Improvements in machinery for folding envelopes, and in the manufacture of envelopes."—6th.

Richard Kemsley Day, Stratford, Essex, hydrofuse manufacturer,—"Improvements in the manufacture of emery paper, emery cloth, and other scouring fabrics."—7th.

John Thom, Ardwick, near Manchester, calico-printer,—"Improvements in cleansing, scouring, or bleaching silk, woollen, cotton, and other woven fabrics and yarns, and in aging fabrics and yarns when printed."—7th.

Joseph Findlay, New Sneddon-street, Paisley, Renfrew, manufacturer, and Andrew Wilkie, same place, turner,—"An improvement or improvements in machinery or apparatus for turning, cutting, shaping, or reducing wood or other substances."—10th.

James Thomson Wilson, Middlesex, chemist,—"Improvements in the manufacture of sulphuric acid and alum."—15th.

Edward Lord, Todmorden, Lancaster, machinist,—"Certain improvements in machinery or apparatus applicable to the preparation of cotton and other fibrous substances."—15th.

Pierre Armand le Comte de Fontainemoreau, 4 South-street, Finsbury, (English and Foreign Patent Office,)—"Certain improvements in weaving."—(Communication.)—22d.

IRISH PATENTS.

Sealed from 21*st July*, 1849, *to* 21*st August*, 1849.

Thomas Robinson, Leeds, York, flax-dresser,—"Improvements in machinery for breaking, scutching, cutting, hackling, dressing, combing, carding, drawing, roving, spinning, and doubling flax, hemp, tow, wool, silk, and other fibrous substances, and in uniting fibrous substances."—August 7th.

John Edward Hawkins Payne, Great Queen-street, Middlesex, coach-lace manufacturer, and Henry William Currie, engineer, in the employ of the said John Edward Hawkins Payne,—"Improvements in the manufacture of coach-lace, and in other similar looped or cut-pile fabrics."—7th.

DESIGNS FOR ARTICLES OF UTILITY.

Registered from 19*th July*, 1849, *to* 15*th August*, 1849.

July 19th,	No. 1967.	Clayton, Shuttleworth, and Co., Stamp End Works, Lincoln,—"Portable corn-mill."
—	1968.	William Handley, Chandos-street, Strand,—"Soil-pan valve."
20th,	1969.	William Stedman Gillett, Woburn-place, Russell-square,—"Diaphragm to be used with a microscope."
23d,	1970.	Auguste Motte, 9 Southwark-square, Southwark,—"Portmanteau."
—	1971.	Richard Bell, Basing-lane,—"Fusee-cutting die."
25th,	1972.	Mary Jane Rummey, Church-terrace, Walworth,—"Brooch protector and pin cap."
26th,	1973.	George Price, Birmingham,—"Stove."
30th,	1974.	Sabina de Canlier, Coleman-street, City,—"The Ottoman cradle."
—	1975.	Miller and Co., 370 Oxford-street,—"Bedside or other table."
—	1976.	George West, Riccarton, Linlithgow,—"Tile machine."
Aug. 1st,	1977.	Robert William Wright, 39 Devonshire-street,—"Compound signet and keeper ring."
2d,	1978.	Theresa Lawrence, Ludgate-hill,—"Ladies' belt, with elastic ligature attached, adapted for other purposes."
—	1979.	Robert Frederick Miller, Hammersmith,—"Omnibus."
4th,	1980.	M. and S. Butcher, Bristol,—"Self-acting laths of iron to metallic bedsteads, sofas, &c."
—	1981.	Sidney Smith, Willenhall,—"Lock."
6th,	1982.	Samuel Denison, Leeds,—"Machine for stretching woven fabrics."
7th,	1983.	John Roe, West Bromwich,—"Horseshoe."
8th,	1984.	John Walker, 48 Shoe-lane, London, builder,—"Effluvia trap for sewers and water-closets."
9th,	1985.	Thomas James Tasker, Great Dover-street, Borough,—"Resilient shirt-collar fastener."
—	1986.	John Roberts, 34 Eastcheap,—"Strawberry tile."
—	1987.	Thomas Waller, Hoxton,—"Fire-lump stove,"
10th,	1988.	Charles Pinnell, Trelick-terrace, Vauxhall,—"Letter-box."
11th,	1989.	Benjamin Frederick Atkinson, Strand,—"Truss."
—	1990.	J. Sparkes Hall, Regent-street,—"Elastic gaiter."
—	1991.	John James, Bishopsgate-street, City,—"Water-trap."
14th,	1992.	William Whitehurst & Co., Oxford-street,—"Graduated carriage-spring."
—	1993.	Jennens Bettridge and Sons, London and Birmingham,—"Writing folio desk."
—	1994.	Thomas Green, Birmingham,—"A set of metallic fittings and variators for lasts and boot-trees, and shoe-cleaners."
15th,	1995.	Jean Francois Isidore Caplin, Berner-street,—"Corsets."
—	1996.	Bernhard Samuelson, Banbury, Oxford,—"Parts of apparatus for cutting turnips and other roots."
—	1997.	Richard Reed Rapson, Penryn,—"Apparatus for dressing flour, &c."

TO READERS AND CORRESPONDENTS.

A synopsis of the leading contents of the eighteen numbers of the *Practical Mechanic's Journal*, already published, has just been issued. It contains a list of the most valuable and interesting subjects which are to be found in this work, with the accompanying copper-plate engravings, arranged in order, under the heads of the respective numbers in which they have appeared. A classified statement of this kind, will, it is presumed, be found useful for general reference, or as an aid in the obtainment of particular parts of the work, which may contain any needed information. The synopsis may be had from the booksellers; or free per post on receipt of *one* stamp.

J. S. S.—We have a paper on the subject in preparation. It will be fully illustrated, in order to give a clear explanation of the invention, which is certainly only vaguely hinted at in the paragraph which we have received.

H. D.—Communications of the kind will be very acceptable.

H. W. S. London.—A note addressed to him through the post has been returned to us. We are not sure that we comprehend the arrangement of feathering paddle mentioned, as it does not appear how the outer circle can be hinged both to the outer and inner edges of the floats, as stated. Perhaps he will go more into the details.

Mr. Geary.—If the question is confined entirely to the altered portion of the original, merely referring to the latter, as formerly published by us, we shall insert it. As it stands, it would simply be a repetition of the substance of the inquiry for the third time.

A Foreign Subscriber may obtain such a crane as he wants from any respectable engineer in London. The choice of a maker depends more on local circumstances, than on any presumed superiority of construction. The makers of the steam crane, engraved in our last number, could supply him, if the locality does not especially govern his choice. See "Glyn on Cranes," published by Weale.

A SCIENTIFIC HOLIDAY.

THE BRITISH ASSOCIATION AND ITS BIRMINGHAM EXPOSITION.

The nineteenth annual gathering of the members of the British Association has this year made Birmingham its scene of action; and, whilst we write, there are congregated within its walls, men from every clime, whose names have added to the catalogue of the ranks of the illustrious of the present century. Although the proceedings of the congress will terminate some time before the issue of this sheet from the press, yet the interest attaching to the many passing events, may perhaps stand as our excuse for tracing, *currente calamo*, a few of the details of what is going on around us.

The General Committee, as the formal opener of the meeting, assembled on Wednesday, the 12th ult., in the Library of King Edward's magnificent school, where the minutes of the last meeting at Swansea were read and confirmed, and the several subsequent proceedings were introduced in the report. In the evening, the annual meeting took place in the Town Hall, when the Marquis of Northampton vacated his presidential chair in favour of the president-elect, the Rev. T. R. Robinson of Armagh, who delivered an eloquent address, from which we have elsewhere made an extract.

On Thursday, the 13th, the real business of the several scientific sections commenced. Section G., Mechanical Science, took up its quarters, along with three others, in the Grammar School,—the President, Robert Stephenson, Esq., in the chair,—the opening paper being by Mr. Ward, on a method of supplying steam-boilers with water, as a substitute for the usual feed floats. Mr. Whishaw afterwards read a paper on a chain-pipe for subaqueous telegraphs. This pipe is a line of metal-tubing, jointed at every two or three feet, and this is used as the containing shell for the wire, covered with gutta percha. Twelve hundred feet have been laid down in the Rhine, near Cologne. It was simply payed out from a vessel, and then pinned down to the bottom. Mr. Roberts of Manchester next read a paper on, and exhibited drawings of, an eccentric guage for wire and sheet metals; after which, at the request of Mr. Webster, Mr. Stephenson gave a short account of the late accident at the Britannia Bridge. A description of a new tide-winding apparatus for clocks, by Mr. Roberts, and some notes on the superiority of macadamised roads for large towns, by Mr. J. P. Smith, concluded the first day's transactions.

In the evening, the Town Hall was filled with a gay company, assembled under the name of a soiree, when an interesting conversazione was formed by the members. M. Gassiot's powerful battery was brought to bear upon the electric light, at the exhibition of which, Mr. Faraday addressed the audience upon the extraordinary power passed through a single wire, simply by a combination of metal plates in an acid solution.

On Friday, Section G. was resumed, the first paper being by Mr. Heaton, on the cause and prevention of oscillation in locomotive engines. That there is a serious amount of vibration arising from the unbalanced action of the cranks and pistons is quite true, yet we very much doubt if it is so far objectionable as to demand the application of such a balancing movement as that proposed by Mr. Heaton. The ordinary rate of movement of the working parts of a locomotive will bear no comparison with that of the model exhibited, which was made excessive, for the purpose of colouring up the bad effect of the oscillation. If complex additions are required to overcome certain defects in mechanism, it is a nice point for consideration as to whether we should not rather submit to slight practical objections, than, by having recourse to counteracting contrivances, add to the first cost and friction of the whole. Mr. Heaton's arrangement is most effective; it is, besides, not very complex, but sufficiently so to render its general application a matter of doubt. The recommendations it involves are, besides, so old and well known, that we are surprised at its being again brought forward here, to the displacement of novelties of greater importance.

In a second paper by Mr. Roberts, attention was directed to the facilities for moulding sheet metal by rollers. Several pieces of rolled metal, intended for the domes of locomotives, and other portions of machinery, were exhibited, showing that the rolling machine may be made extensively available in a great variety of constructions. Amongst other curious productions, it was explained how a deep hollow or bridge-rail, with a wide base, for railways, might be rolled in two processes—the first, forming the rail in a partially bent state, whilst the second bent it up to form.

An ingenious centrifugal pump was shown by Mr. Appold, who worked a small model to exhibit the capabilities of the contrivance, as well for merely elevating large masses of water, as for forcing out small jets to a great height. It is simply a double disc-wheel, having curved vanes disposed near its circumference. It revolves on a horizontal shaft like a water-wheel, just free of the interior of a metal case; and, being driven at a great speed, the water enters the disc by a central aperture on each side, and is thrown out by the vane-passages, to be discharged by a vertical trunk carried up from the case. A disc of 10 feet in diameter is stated to raise 140,000 gallons per minute.—Mr. Davison then read a description of Davison and Symington's desiccating process. It is hardly necessary to remark, that the same objection of want of novelty or general interest applies in this case as in the one previously cited.—The day's proceedings terminated with an account of a water-meter, by Mr. Parkinson. This meter appears to measure very accurately; but as it will not do where pressure is required after measurement, it is inapplicable in the great bulk of cases where the constant pressure system is in use; or, in other words, if introduced, it will nullify many of the advantages which are now presumed to be gained by the constant pressure system.

Saturday, the 15th, was set aside as an excursion day, and a most attractive list of places was presented for the consideration of the members and their friends. Three routes were named. The first to Dudley, to inspect the ruins of the castle, and the celebrated limestone caverns, which were illuminated for the occasion by the direction of the proprietor, Lord Ward. The detachment visiting this locality had also the opportunity of inspecting the limestone-works in the Wren's Nest Hill; the Clay Croft "open works" in the 10-yard coal; Messrs. Cresswell's "open works" in the 10-yard coal; and the iron-works, furnaces, and rolling-mills in the district. The Dudley Geological Museum, and Messrs. Gray and Fletcher's Museums, were also open to the members.

The second route was to Wednesbury, where Messrs. Geach and Walker afforded the visitors an opportunity of witnessing the manufacture of the patent shafts and axle-trees, and engine-works; and here, also, the neighbouring iron-works were thrown open. The third was to Warwick, Kenilworth, Leamington, and Coventry, and with this section of the members we cast our lot. Proceeding direct by the London and North-Western Railway to the Leamington station, we here collected our forces, and found that we numbered amongst us the Rev. the President of the Association; Lieut.-Colonel Sabine, the Secretary, who discharged the office of leader of the party; Professor Sedgwick; J. C. Adams, Esq., Dr. Edwin Lankester; John Taylor, Esq., the Treasurer; T. Webster, Esq.; and several other leading heads of the institution.

Marshalled by Colonel Sabine, we insinuated ourselves into sundry omnibuses and carriages, which were liberally provided for our transit, and were set down at the gate of Warwick Castle. The number of visitors was apparently larger than had been anticipated, as, although we had numbers of conveyances of every grade, some of the last visitors, composed of Dr. Lankester, four ladies, and ourselves, found some difficulty in getting under way. Arrived at the castle, one of the finest scenes in the kingdom awaited us. Each tower has its story, each turret its legend, and whilst some gazed at the rib of the Dun Cow, or pored over the matchless Warwick vase, others gave a microscopical peep at the inlaid table of many stones in the magnificent entrance-hall, explored the nooks and crannies of Guy's tower, or peered into the now silent and empty recesses of the immortal punch-bowl, or, as some have it, Guy's porridge-pot.

To the student of character, ample opportunity was offered for noting curiosities amongst the crowd of inquiring excursionists. In our division, we derived some amusement from the remarks of a south-county man, who reduced everything he saw to the standard of Hatfield House. "Your ceilings," observed he to the obliging conductor, "are not at all to be compared to those at Hatfield;" and on entering the beautiful chapel, the same remark came unceremoniously forth, whilst the groined-roofed kitchen was "far inferior to that at Windsor." So it is that character takes its turns—everything before such an observer is mentally held up, side by side, with some place of former visit, whose fancied superiority eclipses all other charms. In the conservatory, where stands the noble Warwick vase, an old gardener, whose back was bent with accumulated years, took his stand on the base, and held forth in rapid eulogium of his loved possession. From his quaint description, we learned that the vase weighs 8 tons, is 7 feet in diameter at the top, and holds 163 gallons. One onlooker near us, evidently no lover of antiquities, declared his far greater admiration of Sir Edward Thomason's celebrated bronze model of the vase. This model is certainly a very magnificent work of art—so much so, that the Emperor of Russia some time ago offered its possessor £17,000 for it, provided he alone possessed such a copy of the original. It is, however, still in the show-rooms of the works, now those of Messrs. Collis. After leaving the romantic grounds of Warwick, the same excellent arrangement of conveyances took us over to Guy's Cliff, the seat of the Hon. Bertie Percy, the whole of which was thrown open for inspection. A picturesque gateway, surmounted by a bell-turret, conducts the visitor to the court-yard of the house; the base of which, on one side, is on a level with the natural ground, formed into a lovely garden, whilst on the other the windows overlook a precipitous cliff of 60 feet, the foot of which is washed by the clear waters of the Avon. Here, amongst other curiosities, are shown a large collection of paintings, the work of a former owner of the house—many of them evincing very high talent. Here also is the renowned Correggio.

Returning hence to the Leamington station, a train took us to Kenilworth, where a goodly number, headed by the President, prepared themselves for an onslaught upon the venerable ruins of the castle, by partaking of a collation at the King's Arms. The castle, which is reached by a short walk through the pretty village, carries with it too many historic associations not to be looked upon with the most intense interest—and the numerous sketchers around the ivy-mantled ruins, showed that this feeling was universal.

Monday, the 17th, ushered in the third day of the sectional meetings, when the Mechanical Section had first on its list a paper by Mr. Greener, on the manufacture of the finer irons and steels, as applied to gun-barrels, swords, and railway-axles. From the well-known judgment possessed by Mr. Greener in all matters relating to iron, it may be conceived that this paper was of some value, and we shall note some particulars of it in another place. Mr. Whishaw afterwards gave some valuable information "on the present state of telegraphic communication in England, Prussia, and America," with acute dissertations on the merits of the system adopted in each country. The remaining papers of the day were "on a machine for ventilating coal mines," by Mr. Brunton,—"on Neustadt and Barnett's calculating machine," by Mr. Knight,—and "on a rotatory engine," by Mr. M'Gauley,—notices of which we shall give on a fitting opportunity.

Fifty years back, the French set the example of creating and fostering a spirit of emulation amongst their manufacturers and artificers, by instituting public exhibitions of the productions of constructive and decorative art; and with a practical result, which is now evidenced in the perfection attained, not only in every branch then represented, but in all the subsequent introductions and improvements, in the remotest degree connected with those of the time referred to. From the 110 exhibitors in the Temple of Industry, in 1798, receiving 23 rewards, the care and attention of the successive Governments have brought about, in 1849, a collection numbering 4,532 exhibitors, with nearly as many awards of prizes.

Still, with this example before us, we have exemplified the proverbial apathy of our character, by an utter neglect of this most efficient means of promoting the cause of improvement. If we go back a very few years, we find no shadow of an attempt at anything of the kind; for, with the exception of the movements of the Society of Arts, and a few minor exhibitions in one or two provincial towns, it can hardly be said to have received a trial until our own day. The Manchester and Glasgow collections, with the Free Trade Bazaar in London, have shown what could be accomplished; and this year's exposition, under the auspices of the British Association in Birmingham, has, so far, asserted and maintained its right to be termed worthy of this country of mechanical production.

The exhibition-room is a temporary, but most substantial and lofty, wooden erection, in the grounds of, and adjoining to, Bingley House. It is divided, by what may be termed aisles, into three longitudinal sections, the whole erection comprising a length of 124 feet by 90; besides which, Bingley House itself is pressed into service as a receptacle for the heavier class of articles, being united to the large room by a covered passage or corridor. Beginning at the entrance of the grounds, the first objects are a set of cast-iron vases, garden chairs, and the various devices of modern landscape gardening, manufactured chiefly by the Coalbrook Dale Iron Company. Passing through the private rooms at the end, we come at once into view of the vast collection. At the head of the main central line of stalls, is a fine selection of works in metal from Messrs. Winfield's. Here are varieties of ornamental metal bedsteads and fittings, with the varieties of hollow metal works, for which Messrs. Winfield's establishment is so renowned. One of the most beautiful examples is a gasalier, in which the splendour of the brazen stem and branches contrast beautifully with the elegant lilies in opal, which form the light glasses. A curious specimen of work is given in the conical-twisted brass tubing, for which Mr. Winfield has recently obtained a patent.

The splendid candelabrum of Messrs. Osler, forming the centre piece of the whole, is of itself a most attractive object, whilst the surrounding contributions of Elkington, Jennens & Bettridge, and others, add a gorgeous variety to a scene, a suitable account of which we must defer to another month.

ON WATER-WHEELS, WITH VENTILATED BUCKETS.

By William Fairbairn, M. Inst. C.E.[*]

Since the time of Smeaton's experiments in 1759, little or no improvement has been made in the principle on which water-wheels have been constructed. The substitution, however, of iron for wood, as a material for their construction, has afforded opportunities for extensive changes in their forms, particularly in the shape and arrangement of the buckets, and has given, altogether, a more permanent and lighter character to the machine, than had previously been attained with other materials. A curvilinear form of bucket has been generally adopted, the sheet-iron of which it is composed affording facility for being moulded or bent into the required shape.

From a work, entitled "Méchaniques et Inventions approuvées par l'Académie Royale des Sciences," published at Paris in 1735, it appears that, previous to the commencement of the last century, neither the breast nor the overshot water-wheels were much in use, if at all known; and at what period, and by whom they were introduced, is probably equally uncertain. The overshot-wheel was a great improvement, and its introduction was an important step in the perfecting of hydraulic machines; but the breast-wheel, as now generally made, is a still further improvement, and is probably better calculated for effective duty, under the circumstances of a variable supply of water, to which almost every description of water-wheel is subjected. It is not the object of the present paper to enter into the dates and nature of the improvements which have taken place during the last and the present centuries. Suffice it to observe, that the breast-wheel has taken precedence of the overshot-wheel, probably not so much from any advantage gained by an increase of power on a given fall, as from the increased facilities which a wheel of this description, having a larger diameter than the height of the fall, affords for the reception of the water into the chamber of the bucket, and also for its final exit at the bottom.

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[*] Read before the Inst. of Civil Engineers.

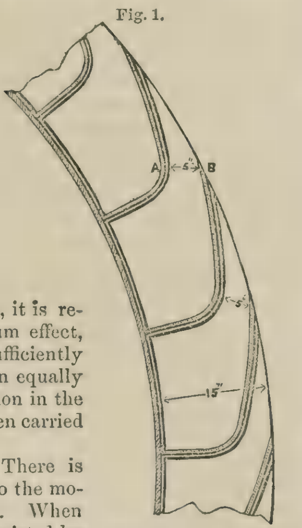
Another advantage of the increased diameter is the comparative ease with which the wheel overcomes the obstruction of backwater: the breast-wheel is not only less injured from the effects of floods, but the retarding force is overcome with greater ease, and the wheel works for a longer time, and to a much greater depth, in backwater.

The late Dr. Robison, Professor of Natural Philosophy in the University of Edinburgh, in treating of water-wheels, says—"There frequently occurs a difficulty in the making of bucket-wheels, when the half-taught millwright attempts to retain the water a long time in the buckets. The water gets into them with a difficulty which he cannot account for, and spills all about, even when the buckets are not moving away from the spout. This arises from the air, which must find its way out to admit the water, but is obstructed by the entering water, and occasions a great sputtering at the entry. This may be entirely prevented by making the spout considerably narrower than the wheel. This will leave room at the two ends of the buckets for the escape of the air. This obstruction is vastly greater than one would imagine; for the water drags along with it a great quantity of air, as is evident in the water-blast, as described by many authors."*

Such were the opinions of one of our first writers on Mechanical Philosophy; but the evil has been subsequently much increased by attempting to form a bucket which should carry the water down to the lowest point of the fall. In these attempts the opening became so contracted as to prevent the free admission of the water from the cistern into the buckets, and its free discharge at the bottom of the wheel.

In the construction of wheels for high falls, the best proportion of the opening of the bucket is found to be nearly as 5 to 24; that is, the contents of the bucket being 24 cubic feet, the area of the opening, or entrance for the water, would be 5 square feet. In breast-wheels, which receive the water at a height of 10° to 12° above the horizontal centre, the ratio should be nearly as 8 to 24, or as 1 to 3. With these proportions, the depth of the shrouding is assumed to be about three times the width of the opening, or three times the distance from the lip to the back of the bucket, as from A to B, fig. 1, the opening being 5 inches, and the depth of the shroud 15 inches.

Fig. 1.



For lower falls, or in those wheels which receive the water below the horizontal centre, a larger opening becomes necessary for the reception of a large body of water, and its final discharge.

In the construction of water-wheels, it is requisite, in order to attain the maximum effect, to have the opening of the bucket sufficiently large to allow an easy entrance, and an equally free escape for the water, as its retention in the bucket must evidently be injurious when carried beyond the vertical centre.

Dr. Robison further observes—"There is another and very serious obstruction to the motion of an overshot or bucketed wheel. When it moves in backwater, it is not only resisted by the water when it moves more slowly than the wheel, which is very frequently the case, but it lifts a great deal in the rising buckets. In some particular states of backwater, the descending bucket fills itself completely with water, and in other cases it contains a very considerable quantity, and air of common density; while, in some rarer cases, it contains less water, with air in a condensed state. In the first case, the rising bucket must come up filled with water, which it cannot drop till its mouth gets out of the water. In the second case, part of the water goes out before this; but the air rarefies, and therefore there is still some water dragged or lifted up by the wheel by suction, as it is usually called. In the last case, there is no such back load on the rising side of the wheel, but (which is as detrimental to its performance) the descending side is employed in condensing air; and although this air aids the ascent of the rising side, it does not aid it so much as it impedes the descending side, being (by the form of the bucket) nearer to the vertical line drawn through the axis."†

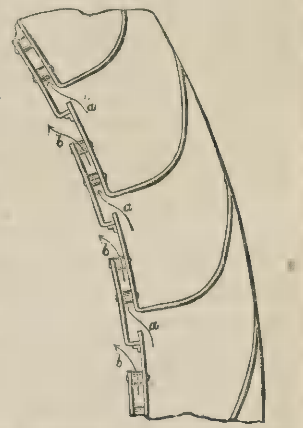
These were the difficulties under which the millwrights of Dr. Robison's time laboured; and the remedy which they applied (and which has since been more or less continued) was to bore holes in, what is technically called, the "start" of the bucket. This was the only means adopted for removing the air from the buckets of overshot-wheels, in order to facilitate the admission and emission of the water. In lower falls, where wheels with open buckets were used, or straight float-boards radiating from the centre, large openings were made in the sole-planking, exclusive of perforations in each bucket, in order to relieve them from the condensed air. The improved construction of the present time is widely different, the buckets being of such a shape as to admit the water at the same time that the air is making its escape.

During the early part of 1825, and the two succeeding years, two iron water-wheels, each of 120 horse power, were constructed in Manchester, for Messrs. James Finlay and Co., of the Catrine Works, under the auspices of the late Mr. Buchanan, and also for the same Company at Deanston, in Perthshire, of which firm Mr. James Smith, Deanston, was then the resident partner. Those wheels are still in operation; and, taking them in the aggregate, they probably rank, even at the present day, as some of the most powerful and the most complete hydraulic machines in the kingdom. The construction of these wheels, and others for lower falls, first directed the author's attention to the ingress and egress of the water, and led to the improvements which have since been introduced by him.

The object of these modifications may be generally stated to have been for the purpose of preventing the condensation of the air, and for permitting its escape, during the filling of the bucket with water, as also its re-admission during the discharge of the water into the lower mill-race.

Shortly after the construction of the water-wheels for the Catrine and Deanston Works, a breast-wheel was made and erected for Mr. Andrew Brown, of Linwood, near Paisley. In this it was observed, when the wheel was loaded, and in flood waters, that each of the buckets acted as a water-blast, and forced the water and spray to a height of 6 or 8 feet above the orifice at which it entered. This was complained of as a great defect; and, in order to remedy it, openings were cut in the sole-plates, and small interior buckets were attached to the inner sole, as shown at *b b b*, fig. 2. The air, in this case, made its escape through the openings, *a a a a*, into the inner bucket, and passed upwards, as is shown by the arrows, through *b b b*, into the interior of the wheel. By these means it will be observed, that the buckets were effectually cleared of air whilst they were filling; and that, during the obstructions of backwater, the same facilities were afforded for its re-admission, and the discharge of the water contained in the rising buckets. The effect produced by this alteration could scarcely be credited, as the wheel not only received and parted with the water freely, but an increase of nearly one-fourth of the power was obtained; and the wheel, which still remains as then altered, continues, in all states of the river, to perform its duty satisfactorily.

Fig. 2.



The amount of power gained, and the beneficial effects produced, upon Mr. Brown's wheel, induced a new and still greater improvement in the principle of construction; the first wheel erected on this, which has been called the "ventilated" principle, was one designed for Mr. Duckworth, at the Handforth Print Works, near Wilmslow, in Cheshire. This wheel was started in 1828. The improvement of the breast-wheel, with the close sole and ventilated buckets, immediately followed.

Close-bucketed wheels labour under great difficulties, when receiving the water through the same orifice at which the air escapes; and in some wheels the forms and construction of the buckets are such as almost entirely to prevent the entrance of the water, and to deprive the wheel of half its power. These defects may be easily accounted for where the water is discharged upon the wheel in a larger section than the opening between the buckets, as, under such circumstances, the air is suddenly condensed, and, re-acting by its elastic force, throws back the water upon the orifice of the cistern, and thus allows the buckets to pass without their being more than half filled. Several methods have been adopted for relieving them of the air: the most common plan is by cutting holes, as before mentioned, in the sole-plates, close to the back of the buckets, or else making the openings between them much wider, in order to admit the water, and at the same time to allow the air to escape. All these remedies have been more or less effective; but they labour under the objections of a great waste of water and much inconvenience, by the water falling from the openings down upon the lower part of the wheel, exclusive of the puffing and blowing when the bucket is filling.

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* *Vide* Robison's Mechanical Philosophy, vol. ii. p. 598.

† *Vide* Robison's Mechanical Philosophy, vol. ii. p. 599.

Other remedies have been applied, such as circular-tubes and boxes attached to the sole-plates, which, extending upwards, furnish openings into the interior of the wheel for the air to escape; but these, like many other plans, have been, to a certain extent, unsuccessful, owing to the complexity of their structure, and the inadequate manner in which the objects contemplated were attained. In fact, in wheels of this description it has been found more satisfactory to submit to acknowledged defects, than to incur the trouble and inconvenience of partial and imperfect remedies.

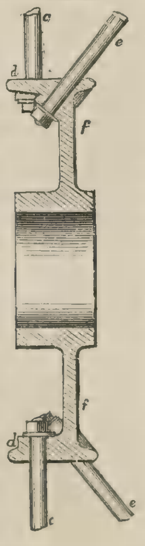
In the improvements made by the author, these objections are to a great extent removed, and a thorough system of ventilation has been effectually introduced. Before entering upon the description of this new principle of ventilation, it is necessary to remark, that, in climates like Great Britain and Ireland, where the atmosphere is charged with moisture for six or seven months in the year, it is no uncommon occurrence for the rivers to be considerably swollen, and the mills depending upon water are either impeded, or entirely stopped, by backwater; while, at other times, a deficiency of rain reduces the water power below what is absolutely required to drive the machinery. On occasions of this kind, much loss and inconvenience is sustained, particularly in mills exclusively dependent upon water as a motive power, and where a number of workpeople are employed.

On the outskirts of the manufacturing districts, where the mills are more or less dependent upon water, these inconveniences are severely felt; and in some situations these interruptions arise as frequently from an excess of water, as from a deficiency in the supply. To remedy these evils, reservoirs have been formed, and wheels have been constructed to work in floods; but although much has been accomplished for diminishing these injurious effects, and giving a more regular supply in dry seasons, yet the system is still imperfect; and much has yet to be done before water can be considered equal, as a motive power, to the steam-engine, which is always available where the necessary fuel is at hand. It is, therefore, obvious, that any improvement in the construction of water-wheels, whereby their forms and requirements may be better adapted to meet the exigencies of high and low waters, will contribute much to the efficiency and value of mills situated upon rivers, and subjected to the changes before alluded to.

Ventilated Water-wheels as adapted to Low Falls.

The first wheel constructed upon the ventilated principle was erected at Handforth, in Cheshire, in the summer of 1828; it proved highly satisfactory to the proprietors, Messrs. Duckworth and Co., and gave such important results as to induce its repetition, without variation, in cases where the fall did not exceed the semi-diameter of the wheel.

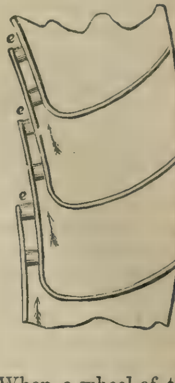
Fig. 3.



In the earlier construction of iron suspension-wheels, by the late Mr. J. C. Hewes, the arms and braces were fixed to the centres, by screws and nuts upon their ends, as shown in fig. 3. The arms, *c c*, passed through the rim, *d d*; and the braces, *e e*, which traverse the angle of the rim at *f f*, are, as nearly as possible, in the position and form adopted by Mr. Hewes. This arrangement, although convenient for tightening up the arms and braces, was liable to many objections, arising from the nuts becoming loose, and the consequent difficulty of keeping the wheels true to the circle, and the arms and braces in an uniform state of tension: gibs and cotters were therefore substituted for the nuts and screws; and since their introduction into the large wheels of the Catrine Works, Ayrshire, the objections have been removed, and the arms and braces are now not only perfectly secure, but the periphery of the wheel is retained in its true and correct form.

Having noticed the obstructions offered to the entrance of the water into buckets of the usual form, and the consequent loss which ensues from its retention upon the wheel after its powers of gravitation have ceased, it may be necessary to show the means whereby those defects were removed, and also to exhibit the relation existing between the breast and the undershot wheels. These terms have, however, become nearly obsolete, as every description of water-wheel may now be properly called a breast-wheel; and in every fall, however low, it is generally found advantageous for the water to act by gravitation, and not by impulse, as during the earlier periods of the industrial arts.

Fig. 4.



If the process of filling and emptying the buckets of the wheels, shown in fig. 4, be traced respectively in each, it will be found, that in the event of a large body of water being discharged into the buckets at fig. 4, they could not be filled if the openings at *e e* were closed, and the air was prevented from escaping in that direction. Under these circumstances, the air would be compressed and pent up in the bucket, and the water be prevented from entering, or be blown out, as already described.

Now this is not the case when they are properly ventilated, as a perfectly free passage is constantly open for the escape of the air in the direction of *e*, and an equally free entrance is again afforded for the water; the passage for the escape of the air being represented by the direction of the arrows through the openings, *e e* and *e*, and also the connection of the buckets with each other, by rivets and tubular blocks. When a wheel of this description is heavily loaded, a small quantity of water will sometimes escape along with the air, above the lip of the outlets, *e e*, into the interior of the wheel; but that is of little consequence, as it is again received into the buckets as it falls upon the wheel; and even this defect may be removed, by carrying the edge of the plate higher upon the sole of the upper bucket. For low falls, the length of the tail-side of the bucket will, however, be found in practice quite sufficient, either as regards the economy or the distribution of the water.

Having treated of the entrance of the water into the buckets, it is necessary to describe the facilities afforded by this construction for its discharge. A quick and easy outlet for the water, when no longer required upon the wheel, is as important as an expeditious inlet; and it is evident that every drop of water which is carried by the wheel beyond the vertical line of the centre, is so much useless absorption of its power; moreover, in the construction of the bucket for the reception of the water, strict reference should also be had to its free and uninterrupted discharge. Another main point of consideration is the distance to which the water is carried, by its momentum or centrifugal action, when leaving the wheel; and it will be found advantageous to effect the discharge of the water as soon as the bucket passes the lower edge of the stone-breast. This discharge being seldom accomplished in time in the old wheels, was a serious counterpoise to the power of the wheel, as the ascending buckets carried with them portions of the water to a considerable height, on the opposite side of the vertical centre. In the improved construction this defect is obviated; as the opening which allows the air to escape during the filling of the bucket, re-admits it with the same facility during the discharge; there cannot, consequently, be any formation of a partial vacuum; and the wheel not only works easily, but to a much greater depth in the backwater. It has also been found necessary, in order to facilitate the escape of the water, to terminate the breast at a distance of about ten inches from the vertical centre, and always to have a depth of from eighteen inches to two feet of water under the bottom of the wheel.

These are considerations of some value, as the abrupt termination of the breast admits of a much quicker discharge of the water from the buckets; and the increased depth of the tail-race gives room for its escape, after it has passed from the wheel. In fact, the benefits arising from this form of breast and tail-race are so great, that they should be strictly enforced where it is desirable to have the full and effective use of the fall. In the erection of water-wheels, these principles should never be lost sight of; and instead of a shallow tail-race, with the water running from the wheel at a rate of from six feet to eight feet per second, as is frequently the case with the old wheels, the current should be scarcely perceptible, and the water should flow steadily, and as smooth as in a deep canal.

It would perhaps be difficult to describe with accuracy the properties and proportions of these improvements, without a long series of costly experiments upon a large scale; and in order to make the comparison perfect, the new and old forms of water-wheels should be placed in juxtaposition, each having a proportionate load, and working as nearly as possible under the same conditions, both as to the fall and the supply of water. Under these circumstances, the great difference which exists between the one kind and the other would become apparent, not only as respects superior economy, but also the perfect ease with which the ventilated wheel overcomes the resistance of the load, and the obstructions of backwater, to which wheels are subject during floods.

On some future occasion an opportunity may present itself for returning to this subject, when the superiority of water-wheels with ventilated buckets may be confirmed by more detailed experiments, and when the relative forms of wheels and buckets may be respectively established. For the present, it will suffice to observe, that the wheel already described will be found in practice exceedingly effective, and probably the best adapted, with certain modifications, for falls not exceeding ten feet in height.

PHYSICAL GEOGRAPHY.

No. I.

When the general figure of our globe, and its relation to the other parts of the universe, have been ascertained by Astronomy and Mathematical Geography,—when the phenomena of its atmosphere, and the operation upon its mass, of the laws of light, heat, electricity, and magnetism, have been considered under Meteorology and the Physics of the Globe, there remains to describe the natural divisions of its surface—the form, size, height, or depth of its oceans, lakes, rivers, continents, mountains, valleys, &c., under the head of Physical Geography. To the botanist must be left the study of its vegetable productions; to the mineralogist and chemist, that of its inorganic constituents; to the geologist, its history during those ages in which man was not an eye-witness of the changes which it underwent; but it is fairly within the province of the geographer to describe, not merely its configuration, but the changes which its surface is now suffering.

The names which have been given to the different features of land are chiefly the following:—Mountains are the most considerable eminences of the globe; those of lesser elevation are termed hills. A volcano is a mountain which vomits flames, lava, or mud. A plain is formed by a uniform level, or one interrupted by few variations of altitude. Steppes, savannahs, landes, pampas, llanos, names given in different parts of the world to vast uncultivated plains covered with vegetation; and deserts are sterile plains without water or vegetation. Plateaux are elevated plains. Mountains rarely stand alone; they are usually in groups, or arranged in chains. They are divided from each other by valleys, which are generally at right angles to the direction of the chain. Valleys that are narrow and bounded by perpendicular banks, take the name of gorges or ravines. Passes are depressions in a mountainous ridge, by which access is obtained from one valley to another. With reference to the relations of land to water, the following names have been given:—An island is a portion of land smaller than a continent, and surrounded by water on all sides. An assemblage of several islands in close neighbourhood, is termed a group, or an archipelago, according to their importance, number, and distance. A peninsula is a projection from a continent, and united to it merely by a narrow thread of land; the latter being called an isthmus. A cape, promontory, or point, are also pieces of land projecting into the water.

The extent of dry land compared with that of water, is as 100 to 280, or thereabouts. The northern hemisphere contains about three times as much land as the southern, the proportions being 197·2 to 68·7. It is yet unknown whether sea or land surrounds the earth's poles; for no one has penetrated farther north than the parallel of 82° 55′, or farther south than that of 78° 10′.

The superficies of the great divisions of the globe is shown in the following table. The first column gives the area in thousandths of the earth's surface; the second, in square marine leagues:—

Europe,	15·6989	304,000
Asia,	88·7320	1,346,000
Africa,	59·5764	958,000
North America, South America,	91·2573	607,000
New Holland,	9·9063	571,000
Smaller Islands,	0·7524	
	265·9233	

The whole superficies of the globe is usually estimated at 196,816,658 square miles; of which the land occupies 52,353,231 square miles, and the ocean 144,463,427 square miles.

The continental masses are twenty-three times larger than the whole of the insulated portions of the solid surface of the globe. With respect to the two great continents, it is to be observed, that their major axes are in opposite directions, whilst both terminate on the north in a line which is nearly coincident with the 70th parallel; and, on the south, they severally stretch out into pyramidal points, submarine prolongations of which appear to be indicated by islands and shoals. The southern extremity of America is the nearest approach of a continent to the south pole. The pyramidal form of termination is frequently repeated on a smaller scale in the Indian Ocean and in the Mediterranean. Europe, with a surface one-fifth the extent of Asia, may be considered as a peninsula of the latter. The direction of the old continent is sensibly parallel to the equator; that of the new is perpendicular to it. Both are interrupted by an isthmus—that of Suez, and that of Panama. The depression forming the bed of the Atlantic Ocean is like a huge valley, in which, judging from the parallelism of opposite coasts, the flow of water was directed first towards the N.E., then towards the N.W., and again towards the N.E.

Taking the mean of all the calculations, the density of the land is 5·66 greater than that of the water. The mean density of the outer crust, both land and water, not being more than 1·6 of the density of the globe, it follows, that the strata of the interior must be extremely compact and heavy, either from pressure or metallic matter.

Various causes have operated to elevate the land above the sea, and to raise up the numerous inequalities of the former. Forces, having their seat within, have doubtless been the most active,—sometimes elevating, with a mighty upheaving power, chains of mountains thousands of miles in length; at others, raising with a scarcely perceptible motion a vast extent of surface. The coasts of Norway, Sweden, and Finland, are now rising at the rate of four feet in a century. Large vessels can no longer, as formerly, anchor before the town of Torneo. Piteo, which was once a port, is now some thousands of yards distant from the sea. In the neighbourhood of Uddevalle, in Sweden, shells have been found eighty yards above the sea's level, adhering to the rocks upon which they had lived. At St. Hospice near Nice, at Cagliari in Sardinia, and on the coasts of Greece, similar phenomena have been noticed.

Whilst it is clear that immense tracts of land are slowly being emancipated from the dominion of the ocean, there is reason to believe that equally large areas have a movement in the opposite direction. An attentive consideration of the phenomena attending the formation of coral islands in the Indian and Pacific Oceans has led to this conclusion. In those oceans the coral formations are of vast extent. On the north-east coast of Australia, a coral reef runs continuously for nearly 1000 miles parallel to the coast; and the islands in the Pacific, made by the coral insect, extend along a line upwards of 4000 miles in length. The little animal which thus builds beneath the ocean on a scale far exceeding that of man above it, is a polyp, that has the power of secreting carbonate of lime from the lower part of its body. The lime is deposited so as to form a cell for the dwelling of the animal; and the building being founded on solid rock beneath the water, mounts upwards in various shapes, (sometimes branched like a tree, sometimes grouped like a cauliflower,) until it reaches the surface. The progress of the edifice is, of course, very slow; generations of insects die off, and are succeeded by others, who carry on the labours of their predecessors until the topmost turrets reach the atmosphere. Now it is an ascertained fact, that the polyp cannot work at a depth in the water beneath that of the lowest spring tides; and yet it is a fact, that coral is found at a depth of several hundred feet beneath the surface of the water. This apparent discrepancy in the results of observation is explained, by supposing that the bottom of the ocean in these coral regions is gradually sinking from the action of subterranean causes. As the rocks, which were near the surface when the polyps began to erect their habitations, subside into lower depths, the insects are obliged to continue building incessantly upwards, in order to keep out of that depth of water which would put an end to their existence. The shape of the foundation will, of course, determine the shape of the coral erection when it comes into view; a submerged ridge will give rise to a coral reef—a circular island will occasion a lagoon, *i.e.* a cup-shaped mass of coral.

Hence it is inferred:—1st. That linear spaces of great extent are undergoing uniform movements, and that the bands of elevation and subsidence alternate. 2d. That the points of eruption (volcanos, &c.) fall upon the areas of elevation. 3d. That when we behold more than half the globe divided into symmetrical areas, which have undergone certain known movements within a limited time, we obtain some insight into the system by which the crust of the globe has been modified during its long cycles of change.

The following are the areas in the southern regions of the globe affected by the grand movements in question:—The West India Islands and bottom of the Pacific Ocean, from the South American coast to the Sandwich Islands (both inclusive), form an area of elevation. The rest of the Pacific Ocean, its islands, and Australia, are within an area of subsidence, which is succeeded by another area of elevation, including Ceylon and all the Indian islands eastward, Sumatra, Borneo, the Philip-pines, Ladrones, &c. Within a curved boundary of this area in the Chinese Sea, north of Borneo, there is an area of subsidence. A large portion of the Indian Ocean west of Ceylon, including the Maldives, islands to the south of them, and the Egmont Isles, fall into an area of subsidence, which probably extends through Keeling Island to the Australian coast. Another area of elevation includes the east coast of Africa, Madagascar, Mauritius, and the adjacent islands south of the equator, and west of the 59th parallel of E. longitude. The middle of the Red Sea has subsided; its two extremities have been elevated.

It would seem that the mountain ridges of the same geological epoch follow a common direction. The general direction of the land in Europe is from S.W. to N.E., at right angles to the direction of the great fissures. Humboldt calculates that, if the matter composing the Pyrenees were spread equally over France, the surface of that country would be raised 115 feet; and if the Alps were laid in like manner over Europe, it would be higher by 21·3 feet. He also estimates that the centre of gravity of the land at present above the surface of the ocean, is, in Europe 671, in North America 748, in Asia 1,132, and in South America 1,151 feet above the sea's level; and that the mean height of these continents is 1,020 feet—so that Laplace's estimation of 3,276 feet, is, at least, three times too great. We have no sufficient data to enable us to make a calculation with respect to Africa. A comparison of these numbers with the table giving the area of the several divisions of the solid portion of the globe, will show in which of them the action of internal forces has most intensely shown itself at the surface. The highest mountains of the globe are found amongst the Himalayas, the chain which divides the valley of the Ganges from the Chinese dominions. Forty of the peaks are higher than Chimborazo; and the highest of all Dhawalagiri is said to reach the enormous altitude of 26,862 feet. The valleys are crevices, and many of the passes across the chain are considerably higher than Mont Blanc. The length of the chain is 1,900 miles, its average breadth 90 miles, and it covers an area equal to 160,000 square miles; its average height is estimated by Berghaus at 15,700 feet.

The immense mountain chain of the Andes occupies nearly one-sixth of South America; its length is about 4,500 miles. The highest summits are found in that portion of it called the Bolivian Andes. In North America, the Stony Mountains, and their prolongation in Mexico, have a length of 7,000 miles; and the Altai chain in Asia, a length of 5,000 miles. The Ural Mountains, which divide Asia from Europe, are nearly 1,500 miles long. After these, the Alps and Appennines, with a length of 600 or 700 miles; and the Pyrenees, with a length of 200, are comparatively trifling chains.

The altitude of the highest mountain bears a very inconsiderable proportion to the mass of the globe; and its spherical form can scarcely be said to be altered by all the chains and groups which rise from its surface.

The following table gives the height of the principal mountains in the various quarters of the world :—

ASIA.	Height in feet.
Dhawalagiri, Himalaya,	26,862
Chamalari, ,,	26,000
Jawahir, ,,	25,749
Gosaingsthan, ,,	24,740
Salpu, ,,	24,243
Many peaks in this range between 15,000 and	24,000
Son Tchookesur, Peschawer,	22,500
Mouna Kah, Sandwich Isles,	18,400
Ubrooz, Caucasus,	17,785
Ararat, Armenia,	17,266
Mouna Roa, Sandwich Isles,	16,020
Petsha, Chinese Tartary,	16,000
Sooinoonang, Thibet,	14,500
Kazbeck, Caucasus,	14,500
Demawund, near Teheran, Persia,	14,300
Ophir, Sumatra,	13,842
Dupha Boom, Langtan Mountains,	13,713
Soconda, Chinese Tartary,	12,800
Egmont, New Zealand,	11,483
Italitzkoi, Altai Mountains,	10,735
Lebanon, Western Asia,	9,520
Pedrotallagalla, Ceylon,	8,280
Olympus,	6,500
Padwinski, Ural Mountains,	6,397
Sinai,	5,000
Ida,	4,960
SOUTH AMERICA.	
Nevado de Sorata, Andes,	25,000
Nevado de Illimani, ,,	24,450
Aconcagua, ,,	23,000
Gualatieri (Volcano) ,,	22,000
Chimborazo (Volcano) ,,	21,420
Nevado de Chuquebamba, Andes,	21,000
Cayambe Urcu, ,,	19,648
Antisana (Volcano), ,,	19,136
Cotopaxi (Volcano), ,,	18,890
Nevado de Chorolque, ,,	17,548
Yliniza, ,,	17,376
Cerro de Potosi, ,,	16,037
Many other peaks in the Andes from 14,000 to	17,000
NORTH AMERICA.	
Popocateptl, Mexico, (Volcano)	17,716
Pico de Orizaba,	17,371
Nevado de Mexico,	15,700
Many other peaks in the same chain from 10,000 to	16,000
Mount St. Elias, North-West Coast,	12,670
Mount Fairweather, ,, ,,	8,970
White Mountains, Massachusetts,	6,234
Werner Mountains, East Coast of Greenland,	6,000
Kaatskill, New York,	3,454
Alleghany Ridge,	3,000
Apalachian Peak,	2,700
EUROPE.	
Mont Blanc, Switzerland,	15,781
Monte Rosa, ,,	15,585
Ortler Spitz, Tyrol,	15,430
Louceira, Hantes Alpes, France,	14,451
Finsteraarhorn, Switzerland,	14,116
Jungfrau, ,,	13,720
Gross Glockner, Tyrol,	13,713
Schreckhorn, Switzerland,	13,397
Breithorn, ,,	12,800
Mulahacen, Sierra Nevada, Spain,	11,673
Mont Cenis, Switzerland,	11,460
Mont Perdu, Pyrenees,	11,283
Etna, Sicily,	10,963
Maladelta, Pyrenees,	10,857
Aiguille Noie, Dauphine,	10,505
Little St. Bernard,	9,594
Lomnitz, Hungary,	8,540
Guadarrama, Spain,	8,500
Orbelus, Greece,	8,500
Le Gran Lasso, Italy,	8,455
Sneeh-attan, Norway,	8,115
Parnassus, Greece,	8,000
Pindus, ,,	7,000
Snaefell, Norway,	6,860
Mont d'Or, Auvergne,	6,707
Athos, Greece,	6,700
Olympus, Greece,	6,500
Rigi, Switzerland,	6,050
Dole, Jura,	5,412
Snee Kopf, Riesengebirge, Silesia,	4,950
Hecla, Iceland,	4,900
Dovrefeldt Range, Norway,	4,875
Puy de Dorne, Auvergne,	4,750
Ben Macdui, Scotland,	4,418
Ben Nevis, ,,	4,358
Cairngorum, ,,	4,050
Albanian Mountains, Greece,	4,000
Vesuvius,	3,978
Ben Lawers, Scotland,	3,944
Ben More, Assignt,	3,903
Ben More, Perthshire,	3,818
Brocken Harts,	3,690
Snowdon, Wales,	3,571
Macgillicuddy's Reeks, Ireland,	3,419
Scawfell, Cumberland,	3,160
Sleibh Dorin, Derry, Ireland,	3,150
Helvellyn, Cumberland,	3,055
Skiddaw, ,,	3,022
Rock of Gibraltar,	1,500
AFRICA.	
Geesh, Abyssinia,	15,000
Amid, ,,	13,000
Peak of Teneriffe (Volcano),	12,036

	Height in feet.
Chain of Lupata, South Africa,	12,000
Atlas, Morocco,	11,400
Clarence Peak, Fernando Po,	10,655
Niewveldt, Cape of Good Hope,	10,000
Gros Morne, Bourbon Isle,	9,600
Pico Ruivo, Madeira,	6,000
Table Mountain, Cape Town,	3,582
Diana's Peak, St. Helena,	2,692

To the summits of most of the loftiest of these mountains, man has never yet been; and on account of the rarity of the air, they may be considered inaccessible by any mode of approach. Gay Lussac attained a height of 22,900 feet in a balloon. Humboldt ascended Chimborazo to the height of 19,400 feet. Since we have no reason to suppose that any portion of the earth's interior, much deeper than 21,000 feet below the sea's level (that being the calculated depth of the dip of the coal strata in the district of Duttweiler, Germany), has been inspected by man, it would seem that, reckoning from the highest summit of the Himalayas to the lowest portion of the basins which contain the vegetable remains of an earlier state of the globe, the whole range, in a vertical direction, of our knowledge of the globe, is only about $\frac{1}{435}$ of the earth's radius. All that lies beneath "is as unknown to us as the interior of the other planets of our solar system." The following table gives the depths of several mines or bores in various parts of the world. The first column of figures represents, in English feet, the absolute depth, or that below the surface of the earth where the entrance was effected; the second represents the relative depth, or that below the sea's level:—

	Absolute depth.	Relative depth.
Salt Works, Neu-Salzwerk, near Minden, Prussia,	2,231	1,993
Artesian Well, Grenelle, Paris,	1,794	
Boring for fire-spring in province of Szu-tschuan, China,	3,197	
Mine at Monte Massi, Tuscany,		1,253
Coal Mine, Apedale, Staffordshire,		2,175
Monkwearmouth Coal Mine, near Newcastle,		1,496
Esperance Coal Mine, Seraing, Belgium,		1,355
Eselschacht, Bohemia,	3,778	
Mine in the Saxon Erzgebirge, near Freiberg,	1,944	675
Joachimsthal Mine, Bohemia,	2,120	
Samson Mine, Andreasberg, Harz,	2,062	
Valenciana Mine, near Guanaxuato, Mexico,	1,686	

Many portions of the earth's surface are marked by plains of vast extent. These are at various heights above the level of the sea; but when they are more than 18,000 feet high, they receive the name of *plateaux*. In Central Asia, there is a plain of 18,000 square leagues, a great part of which is *below* the level of the ocean. The tract includes the Caspian and Aral Seas. The Caspian Sea has been stated to be about 83½ feet below the ocean, and the Aral Sea about 33½ feet above it, though some believe that both are on the same level, and in a depression of the earth's surface. It is conjectured, that at some early period this portion of the globe was covered by a great sea, of which the Caspian and Aral are remains. The Ural Mountains divide an enormous plain into two parts, which together occupy an area of six and a half millions of square miles. In North Africa there is a level tract principally covered with sand, with a superficies of 2,200,000 square miles. There are very extensive plains in the interior of South America. The Llanos are plains bordering on the Orinoco, covering an area of 260,000 square miles, only partially clothed with vegetation. On each side of the Amazon are plains occupying a total area of nearly two and a half millions of miles, a great part of which is densely wooded. Another great level, the Pampas, stretches from Buenos Ayres to the Andes, a length of 1,800 geographical miles, with a width varying from 300 to 900 miles. Those plains which have a considerable altitude, and have steep acclivities on every side, are denominated *table-lands*, the most extensive of which is in Central Asia. Very little is known of it, but its height is stated to be between 9,000 and 10,000 feet. In Mexico is a table-land 7,000 feet high. In South America there are the table-lands of Quito and Riobamba, with elevations of 8,000 and 10,800 feet. The plain of Titicatoo has an elevation of 13,000 feet. The interior of Spain is a table-land elevated 1,900 feet.

If the heat of the globe increases as we advance towards the centre, as rapidly as through that portion of the crust within reach of our instruments, then we may suppose that granite is in a state of fusion at a depth of 21 geographical miles. From this theory of the internal heat of the globe, we obtain explanations, not only of earthquakes and of volcanic eruptions, but of the gradual elevation of continents, and the foundation of mountain chains. The shock of earthquakes is propagated chiefly in a linear direction, by undulations having a velocity of from 20 to 28 geographical miles in a minute of time, and sometimes in circles or ellipses, in which the shocks are propagated from the centre to the circumference. Some districts are within the reach of two intersecting circles of commotion; the shocks are usually accompanied by hollow noises of more or less intensity, but sometimes such noises precede, sometimes they follow, the shock by an interval of many minutes; and it would appear that, occasionally, loud subterranean noises have been heard unaccompanied by any motion of the ground. In January, 1784, in the Mexican territory, subterranean noises were heard that lasted for a whole month, whilst not the slightest trembling of the ground was perceptible. For some days it was as if there were heavy storm-clouds under the feet of the inhabitants, in which slow rolling thunder alternated with short thunder-claps. The influence of an earthquake is sometimes limited to a few miles, at others it extends over many thousands, and the destruction of life and property varies in like manner. The most dreadful earthquakes on record are that of the year 526, when 250,000 persons were killed at Antioch: that of 1755, when all the great buildings at Lisbon, and one-fourth of the private houses were thrown down, and 30,000 lives were lost. This earthquake shook a region four times greater than Europe—Greenland, Norway, Central Europe, Africa, and the West Indies, were all affected. In 1793, an earthquake destroyed 60,000 persons in Sicily; and in 1797, a tremendous earthquake destroyed 35,000 at Riobamba, in South America. Earthquakes have occasionally elevated large districts permanently above their former level; and during their occurrence, various matters, hot water, steam, smoke, gases, &c., have issued from the ground. In 1809, the earthquake of Cutch raised Ullabund east of the Delta of the Indus: and in 1822, the coast of Chili was raised.

It has been conjectured that earthquakes take place when elastic fluids, subjected to enormous pressure in the interior of the globe, are unable to escape into the space beyond, without violently tearing a passage open. Hence volcanos have been termed safety-valves for the regions that surround them. Most volcanos now in action, are in islands, in mountain chains near the coast, or at the foot of such chains. It was therefore supposed that volcanic eruptions were the result of sea-water filtrating into subterranean cavities containing incandescent matter; but there are several volcanos in the Thian-Chan chain, or Celestial Mountains of Central Asia, which are at distances varying from 112 to 510 marine leagues from the sea; and Humboldt is of opinion, that true volcanic action may be produced whenever a fissure has been opened in the crust of the globe, so as to effect a permanent communication between its interior in a state of fusion, and the atmosphere.

Volcanos appear, in the main, to originate in a sudden elevation of masses of trachyte or augitic rock in a softened state—the intensity of the upheaving force being measured by the height of the volcano. Perhaps the four most remarkable volcanos in the world are Vesuvius, 3,978 feet; Etna, 10,963 feet; the Peak of Teneriffe, 12,036 feet; and Cotopaxi, 18,890 feet; the last being affirmed by Humboldt, to be at once the most regular and the most picturesque of all those he had seen. The crater is almost always placed at the apex of the cone, forming a deep circular cup, the bottom of which is constantly changing. In this cup there are fissures from which vapours escape, or small hollows filled with matter in a state of fusion. The ground swells and subsides; mounds of cinders are thrown up, and cones of eruption sometimes rise as high as the edge of the crater; the bottom is frequently accessible. In some volcanos, eruptions do not take place from the crater, but from openings found in the side of the mountain. Lava, the molten mass which issues from a volcano, and pouring as a stream down the side afterwards, solidifies on cooling, varies in its mineral composition with the nature of the crystalline rock of which the volcano consists. Vapour, which is chiefly pure, aqueous vapour, is thrown out on an eruption in large quantities: ashes have been known to be ejected in such abundance as to darken the air for days; and flames, attributable to the combustion of inflammable gases, frequently accompany violent eruptions of scoriæ and stones, the latter being generally of that cindery kind termed pumice.

Volcanos appear to be arranged in two ways: in groups and in lines. In the former case, numerous orifices of eruption are distributed around a central volcano; in the latter, the mouths or vents seem placed along some grand fissure in the crust of the earth, as in the Andes and in Mexico. The equatorial regions of the Pacific seem to be a grand theatre of volcanic action. About 195 active volcanos are known at this day, viz.: 1 in the European continent, 12 in European islands, 97 in the American continent, 19 in American islands, 8 in the Asiatic continent, and 58 in Asiatic islands. Several new volcanos have burst forth in historical times, such as the Monte Nuovo, near Naples, which in 1538 was elevated in a day and a night; and the mountain Jorullo, which in 1759 was raised nearly 1,700 feet, after eighty days of earthquake and tumult. Subterranean movements have sometimes thrown up islands in the ocean, or a mountain in a continent, without forming the orifice which completes the idea of a volcano. For instance, an island was thrown up in 1831 on the coast of Sicily, and a new island has appeared near St. Michael's in the Azores. A great number of islands owe their existence to volcanos; such are Iceland, Madeira, and Owyhee. The number of extinct volcanoes is much greater than those still in activity. Auvergne in France, and the Eifel country on the Rhine, are full of volcanos, which ceased to show signs of activity before the era of history.

Liquids and gases are found issuing from the ground in various places, and these emissions are not peculiar to volcanic districts. Sulphur has been found in South America deposited in mica slate by hot sulphureous vapours; and near Quito there is an immense deposit of sulphur embedded in pure quartz; ammonia is sublimed in crevices, and forms a solid crust in clefts of rocks in the Hill of Khobok, near Lake Dsaisang. Sulphurous acid, hydrochloric acid gas, carbonic acid, sulphuretted hydrogen, carburetted hydrogen, and nitrogen, are emitted from fissures in different localities. At Fredonia, in the state of New York, there is a spring of carburetted hydrogen which is made use of for culinary purposes and for illumination. Carbonic acid rises into the atmosphere in large quantities. One of the sources of the Arkansas is formed by some springs, so strongly impregnated with the acid, that it escapes from the water as soon as it reaches the air, and gives it the appearance of boiling smartly. In the province of Chan-si, Chinese Empire, there is a ravine ten paces wide, and at the bottom of it a cavern of unknown depth, with a mouth of about a foot in diameter, from which constantly rushes a wind, so cold that no one can bear to remain there for any length of time. Not far distant there is a crevice from which a powerful heat is emitted, and a continual noise like thunder. Salses are emissions of mud from orifices in the ground. There is a mud volcano on a peninsula on the Caspian, from which, when it burst forth in 1827, flames blazed up to a great height for three hours. Streams of mud have issued from several conical mounds near Girgenti, in Sicily, for fifteen centuries; and at Damak, in Java, mud of a high temperature is thrown from 25 to 30 feet into the air, and hot water, mixed with chloride of soda, hydrogen, and carbonic acid, is discharged along with it.

Between the strata of calcareous rocks there are often found large vacancies, to which we give the name of caverns. Most of them have a narrow entrance, but they afterwards enlarge and consist of several chambers, more or less lofty, containing stalactites and stalagmites. The largest caverns are those of Vallon in Ardèche, Adelsberg in Carinthia, and Antiparos in the Greek archipelago. Sometimes the cavern passes through a portion of a mountain, and is open at both ends; such are the Torgath in Norway, the Pierre Pertuise in the Jura, and the Martin's Loch in Switzerland. The ground of many caverns is strewn with the fossil bones of animals and birds, such as the bear, wolf, fox, elephant, hippopotamus, ox, stag, raven, pigeon, &c.; and petrified fecal matter, named coprolite, has been found scattered about. The caverns of Kirkdale in Yorkshire, of Gailenreuth, Kuhloch, Daumann, and Rabenstein in Germany, of Echenoz and Cette in France, of Antibes and Gibraltar, were the richest in fossil remains. One of the largest caverns in the world is that known as the Mammoth Cave, in the state of Kentucky, U.S., the windings of which have been explored for nine or ten miles. It has no stalactites, but the ground is strongly impregnated with saltpetre, which is manufactured from it in large quantities. Some caverns have an intense cold, and have been called subterranean glaciers and natural ice-houses. There is a freezing cavern in the steppes of the Kirghees, which, during the hottest summer months, is filled with ice: the ice gradually disappears as winter approaches, so that it is entirely gone when the country is clad in snow. There is a limestone cave at Caprino, on the edge of Lake Lugano, the temperature of which was $37\frac{1}{2}°$, when the external air was 79°.

NEEDHAM'S IMPROVEMENTS IN GUNS.

One of the greatest improvements in fire-arms, since the substitution of the percussion for the flint-lock, has recently been patented in this country and in France, by Mr. Needham, the eminent gunmaker of Vine Street, Piccadilly, London, who, by this invention, has added what may almost be termed the perfecting stroke to the modern percussion gun. In illustration of the particulars of the improvement, it is necessary to advert in some degree to the present routine of charging in the ordinary gun. The hammer is drawn back, after firing, to half-cock, when a single percussion-cap has to be separated from a supply carried in a case, altogether apart from the gun furniture, and placed by hand upon the nipple. To save the trouble consequent upon this routine, as well as to prevent the chance loss or injury of caps during removal, Mr. Needham has introduced a self-acting apparatus in connection with the hammer, so that the latter is itself made to put on the caps after firing. Our engraving (fig. 1), which represents a side-view of a portion of a gun, will assist in explaining the mechanism.

Fig. 1.

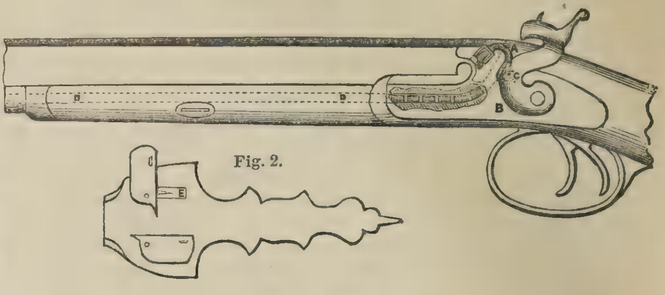


Fig. 2.

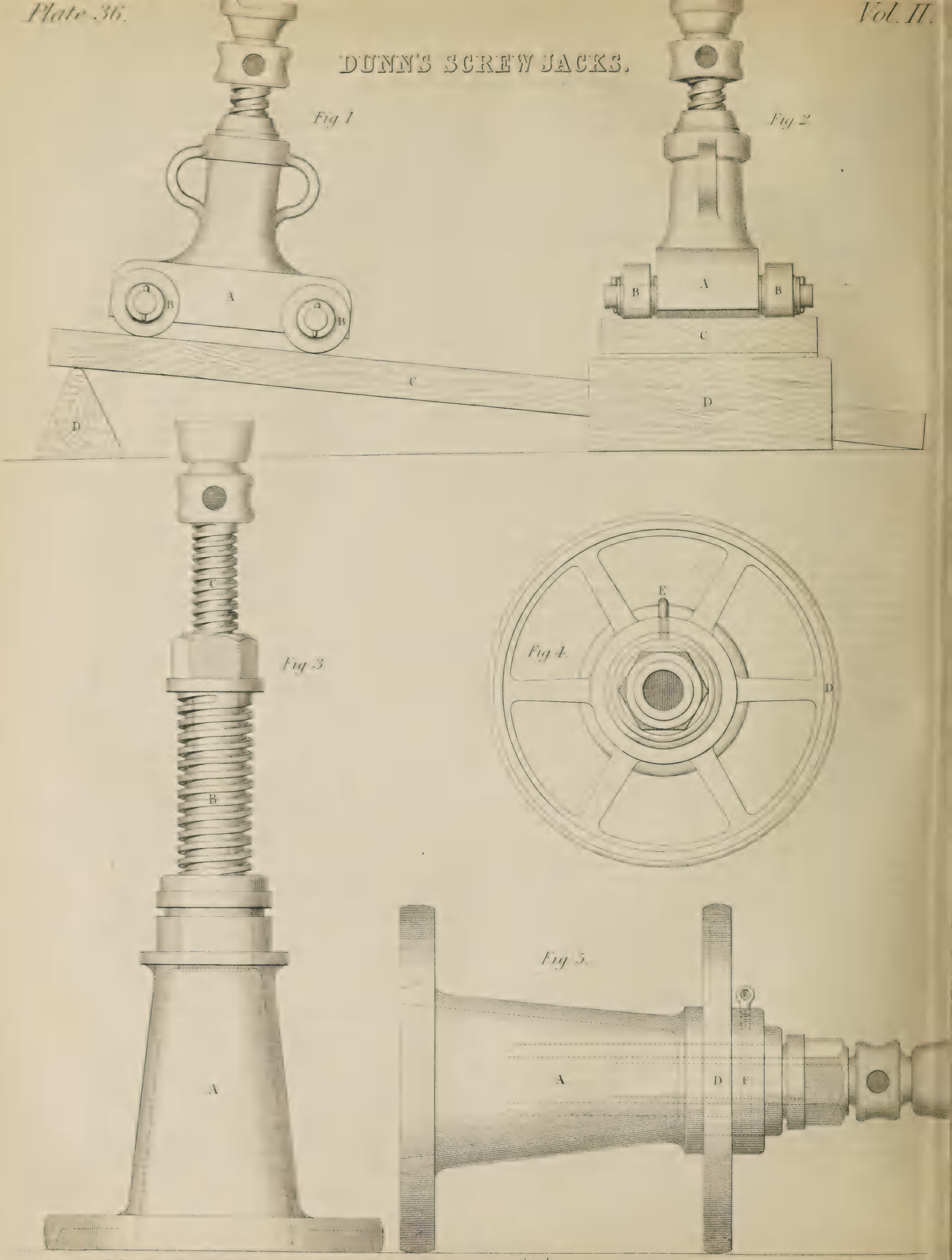
1-4th.

The piece is represented at full-cock; A, is the cap-charger, attached to the plate of the lock, and arranged to move back and forwards in a recess made for it in the plate. On the inside of the hammer, B, there is a small projecting pin at C, which takes into a cleft or notch on the lower extremity of the charger, but has no action upon it, until the hammer is drawn back from half to full-cock, when the pressure of the pin causes the charger to move forward, so as to come directly over the nipple, as represented in our sketch. The magazines for the reception of the caps are situated one on each side of the barrel, one being shown at D D. These magazines are in the form of channels, and are made, either by cutting out in the wood of the stock, or by the insertion of metallic tubes of the requisite bore, which in each case is just large enough to permit the free passage of the caps, without allowing them to turn over from end to end. The entrances for the caps, as placed in a double-barrelled piece, are shown in fig. 2, which is a plan of the lower side of that part of the stock where the channels terminate, towards the muzzle end of the gun. The entrances are rectangular openings, large enough to admit a cap, and having small conical guide-pins set on one side, so that it is impossible to put in a cap the wrong end first. This little contrivance is most ingenious, and prevents all risk of mistakes, which would otherwise constantly occur, in supplying the magazine, by setting the caps with their open ends towards the breech. This can never happen here, as, before a cap can enter, the guide-pin must pass into its hollow or open end. The entrances are closed, after the channels have been charged, by door-pieces turning upon pins. In fig. 2, one of these is open, as at E; the other is closed.

The cap-charging action is very simple. When the butt of the stock is rested on the ground for loading, the gravity of the caps carries them along the channel towards the lock, where they traverse a curved portion at the end, and the lowest cap drops directly into the cup formed in the end of the charger. At this time, of course, the hammer is down upon its nipple, and therefore the charge is in the right position for catching the first cap at the end of the curved channel. When the piece is loaded, and the hammer is brought to half-cock, the cap is retained in its place in the charger until the full-cock is necessary, when the upward movement of the hammer moves the charger forward to place its cap upon the nipple; and, on drawing the trigger, the cap-charger recedes, and takes up its position beneath the hammer, in readiness for supplying another cap for the next shot. The number of caps which a gun can keep in reserve, depends upon the length of the stock; but the patentee states, that the usual length will contain sufficient for a single day's shooting.

Another branch of Mr. Needham's improvements has reference to the prevention of accidents by accidental explosion. A short lever is hinged to the lower side of the butt of the stock, projecting forward towards the lock, this end being sunk in a recess. This free end abuts against a pin projecting from another short lever, turning upon an axis carried by the plate of the lock. The latter lever constantly presses up against the tumbler, being acted upon by a small spring. In this position it takes into the first vent of the tumbler, preventing the hammer from coming down upon the percussion-cap. When, however, the stock is grasped in firing, the hand presses upon the lever hinged to the butt-end, and removes the obstacle to the descent of the hammer. Thus, any accidental pressure upon the trigger alone will have no effect in causing the piece to explode.

DUNN'S SCREW JACKS.



DUNN'S IMPROVED SCREW-JACKS.

(*Illustrated by Plate* 36.)

In this plate are delineated various views of some peculiarly valuable improvements, introduced, under a recent patent, by Mr. Thomas Dunn, of the Windsor Bridge Ironworks, near Manchester, to whom we are indebted for much that is good in our present practice of railway engineering. The ordinary screw-jack, whilst it presents great advantages in point of power, as comprised within the details of a very simple arrangement, is unfortunately by no means a manageable instrument in nine cases out of every ten where its offices are in demand. One of its first uses is comprised in the raising and replacing of locomotives and carriages on the rails after accidental dislodgment, and here Mr. Dunn's plans exhibit their full value.

The first of the two arrangements shown in our plate, is a simplified modification of a traversing-jack. Fig. 1 is a complete elevation of the apparatus, as arranged for traversing a railway carriage or other great weight, where a considerable lateral movement is necessary; fig. 2 is a corresponding view at right angles. The jack itself is of the ordinary construction, the modification having reference entirely to its base or support of the stand. This portion is cast so as to form an expanded rectangular plate, A, which is provided with two axles, carrying the four small wheels, B B. When in action, these wheels rest upon a plank, C, inclined towards the line of rails to which the carriage is to be removed, by placing the block, E, beneath the carriage end. When so placed, the moment the carriage is relieved from its bearing upon the ground by the lift of the jack, its own gravity produces the necessary traverse, the jack, with its load, running down the incline upon the wheels, B B, until the carriage-wheels touch the ground in a fresh position. The same operation is repeated, by again raising the carriage on the high end of the plank, until the necessary traverse has been given, and the carriage arrives at the line of rails, on to which it is ultimately lifted. By lifting the jack off the wheels, B B, it may be used for the same purpose as the ordinary elevator.

For raising locomotive engines and carriages up embankments, where a considerable elevation is required, Mr. Dunn uses what he calls a telescopic screw-jack. Fig. 3 is an elevation of this instrument, with the screws half out; fig. 4 is a plan; and fig. 5, another view with the screws turned in, and a detached wheel shipped on for conveyance. The conical stand, A, of the jack, is cast with a stout circular foot-plate to form a firm foundation; the lower hollow screw, B, works in a thread cut in the upper part of the stand, and it has a hexagonal head for turning. The interior of the head of this screw forms a nut for the upper solid screw, C, to work in. The lower screw, B, has a single thread of 1-inch pitch; and the upper one, C, has a double thread of 1½ inches pitch. In our plate they are each represented as right-hand threads; but the pitch and direction of thread may be varied to suit the peculiar object for which the instrument is required.

If the weight to be raised is comparatively light, the two screws, B and C, may be turned together, so that greater speed of elevation is obtained by the sum of the elevation given by each thread—in the case before us, 2½ inches for each revolution. When a heavier weight is upon the jack, the power is to be applied to one screw at a time, so as to give an elevation of 1 inch, or 1½ inches, at each revolution; and for the heaviest class of weights, the two screws are to be turned in opposite directions at the same rate, by which means the elevation will be only half an inch for each turn of the two.

It is obvious that this duplex screw arrangement affords great facilities for varying the action of the jack; for the relative velocities of the two may be set to give a power of elevation, ranging from the smallest possible fraction of an inch, up to 2½ inches per revolution; and thus, if the details are sufficiently stout, a single jack will answer for raising an immense variety of weights.

A most ingenious contrivance is added for the purpose of providing the convenience of portability—an object of importance in so heavy a mass of metal. When it is to be moved, it assumes the appearance of fig. 5, where the two screws are shown turned in to render it compact; and the wheel, D, of the same diameter as the circular plate of the base, is placed on the top of the stand, A, being held in its position by a pin, E, passing through the boss, and projecting into a groove, F, cut round the stand. Thus, when the screws are passed in to their full extent, the jack is turned over on its side, and may then be easily rolled to its destination. The heaviest jack is by this means rendered remarkably portable. The improvements are being introduced here by Messrs. Shanks & Co., of Johnstone; and in France, by Messrs. Varral, Middleton, & Elwell, and Buddicom & Co., *Ateliers de Réparations Sottesville-les-Rouen*.

DR. ROBINSON'S ADDRESS TO THE BRITISH ASSOCIATION.

NINETEENTH MEETING, BIRMINGHAM,

September 12, 1849.

Hitherto this chair has been filled by men illustrious in the senate or the field, heads of the societies which are the centres of our scientific life, and lodestars of the great institutions which have been, through many ages, the guides of our nation in the progress of intellectual cultivation. Against such men, if I weigh myself, I know how much I must be found wanting. But I trust I may be permitted to regard myself as the type of a humbler but not useless class, for whom this Association was especially devised, and whom it enables to add their tribute to swell the general store. For it is not like the forbidden ground of romance, a region where heroes only can tread; it is not a mere instrument for collecting into a focus the light of the suns of the intellectual sky: it is rather like those machines which unite the power of many, singly weak, but achieving, by the union, works which would overtask the strength of the mightiest individual. In one thing only I will venture to take to myself, as not unmerited, the praise of Lord Northampton. In zeal for the welfare of this Association, in intense interest for the accomplishment of its objects, I yield to none; and if these may suffice, I hope I shall not be found unworthy of the trust you repose in me.

Yet, it is no common responsibility with which you have charged me; for this Association is one of the great powers which the altering phases of the world have called into action. Yet a few years since, and it could not have existed; and even now some persons are found unable to appreciate its results, or understand its purpose. In fact, as the invention of a new machine or process of manufacture is evidence that the old is becoming inadequate to meet the demand which it formerly satisfied, so the feelings which have so successfully called into being our Association here, and similar institutions abroad, may be regarded as a proof that the existing agencies for the development of scientific knowledge were becoming unequal to their work, and that some higher power must be sought, of energy commensurate to the increasing pressure. Such a power, I think, it is now certain that we afford. It is possible that the form of this great experiment may receive some modification; for example, that it may involve a yet wider application of the mighty principle on which it is based, and become a union not only of persons but of institutions. But we have established beyond doubt that it is a trial in the right direction—that its principle is the true one, the principle of association. It may perhaps seem trivial to attach importance to such an assertion: in commercial enterprise, in manufactures, in politics, its truth is universally confessed; what, then, is there new in applying it to science? Nothing, assuredly: in fact, science, at least physical science, owes to it almost its very existence, and certainly its progress; and the wonder is, that none seem to have fully comprehended this before the founders of the British Association. Observe, that though physical science is of recent birth, physical knowledge has been an object of desire from the very origin of our race. Some have followed it for the sake of the powers which it conferred, and some from the high instinct which reveals to a noble mind the beauty and majesty of such pursuits. In the first glimmer of history, the astronomy of the Assyrian magi looms through the darkness; the geometry which might have been its champion and guide, appears in no feeble development almost in the fabulous antiquity of India. The sepulchres of Etruria and Egypt, the palaces of Nineveh, are giving up to us relics of art, that imply in high perfection the existence of that practical chemistry which was transmitted to us through their Arabian successors. When we look at the marvellous architecture of the middle ages, we find a mastery of the principles of equilibrium and pressure, that fills the mind capable of appreciating it with delight, beyond even what its surpassing beauty inspires; and we know, from the writings of Roger, Bacon, and Kircher, that many facts of experimental physics were current in the cloister. The elements were in existence, but some power was wanting which would combine them into a body and give it life. That power was free, open, honest association. Not intellectual energy or acuteness. The Greeks possessed *that* to an extent never perhaps equalled by any other people; but they were made incapable of steady union for any purpose by the strange elements of repulsion, which seemed inherent in their nature, and split their philosophers into sects—their nation into fragments. Elsewhere, the separation was still wider; the priestly castes of old, the conventional clergy, and masonic societies of more recent times, could not coalesce with the rest of the world in the union which I hold to be essential to the growth of science. Therefore, however extensive their knowledge (and they knew more than is generally supposed), it never ripened into general principles; it even became corrupt in the dull stagnation of the mystery in which it was buried—an instrument of superstition or imposture, a delusion to its possessors themselves. Astronomy became astrology—chemistry, alchemy—natural philosophy, magic. Brewster has shown how the concave mirror brought up an apparition when it would, and Boutigny has revealed how the repulsive energies of heat ministered to the iniquity of the ordeal. But this period of isolated labour, under which the intellectual domain of our race lay so long fallow, closed at last; and the principle of association revealed itself at one of the epochs of that movement, which from time to time stirs up the region of mind, as those of geology do the earth at the commencement of some great formation. To borrow from that science an illustration—the reign of reptiles and monsters gave way to higher beings that soared in the sky; the dominion of Aristotle and the schoolmen disappeared before the age of Copernicus, Kepler, Galileo, and Bacon. From the fifteenth century downwards, we find the philosophers of Europe beginning to be worthy of that name. Lovers of knowledge, instead of wrapping up their discoveries in secrecy, using them as a means of influence over the ignorant, or brooding on them as food for haughty self-love, we find them forming a brotherhood of knowledge—eager to communicate their inventions, applying to each other for instruction, and even disputing among themselves the honour of priority in successful research. If the Florentine astronomer still envelopes in cipher his observations of Venus and Saturn, it is lest a rival should anticipate what was necessary to perfect his discovery; while the monk of Oxford hides in a similar veil his knowledge of gunpowder to exalt himself in the opinion of the world, yet keeps his secret. The step in advance was wide, and the onward progress was rapid. It is not merely that each discovery which is thus freely communicated becomes an imperishable addition to the treasury of human knowledge, but it is also a source of others, more numerous as it is more widely diffused, like a singenesious flower, whose winged seeds would produce little if confined to the neighbourhood of their parent, but bear a thousandfold when scattered over the land. He who first finds a physical fact or principle, often fails to trace it to its full extent—preoccupied by some particular object of research, led by special views, he looks at it with reference to them alone; and, were he sole labourer in the mine, much of its wealth would be lost. It may be too vast to be explored by the power of one mind, or within the limits of one life; or it may require aids and appliances which solitary individuals do not possess: to say nothing of what is still more important—the increase of energy which flows from the sympathy and admiration of a multitude. It is not too much to say, that the progress of mankind in science during the two centuries to which I refer, far exceeded what had been made during the fifty-six that preceded them; yet the force which impelled it was only partially and imperfectly exerted, and it was soon felt to be capable of far wider application. In this stage of its action, the principle of association had operated only on a few mighty spirits, whom the sense of kindred pursuits and powers linked together, but from whom their very transcendence kept their humbler fellows at a reverential distance. It was necessary that these also should be included in its bond; and the age of Societies began. By condensing into a multitude of local centres the activity which was weakened in its diffusion, that privilege of labouring to extend the boundaries of knowledge, which had been the glory of a chosen few, was extended to a multitude; societies devoted to this object arose in different countries, varying in constitution and form, but all emanating from the same necessity of bringing united exertion to bear on what every passing year showed to be among the noblest objects of human existence. And in this they were eminently successful;—strong in numbers, they were stronger in local concentration; their definite and permanent organization was a source of life and power, and the visible results of their activity were manifest to the world. In many instances they acquired a legal and corporate existence, which gave them a hold on general opinion, and even on governments; their pecuniary resources and moral weight afforded them the means of researches beyond the reach of ordinary inquirers, and their exclusive character, whether limited by election or by appointment, by making it an object of ambition to belong to them, gained for their pursuits a popularity which their intrinsic worth might not so soon have won. A still more—perhaps their most—important feature is the principle of systematic publication, the value of which has gone on increasing to the present hour, and cannot be overrated. Their transactions gave to the world not merely casual observations, which might otherwise have perished, but elaborate investigations, which probably would never have found a publisher in the ordinary course of trade—perhaps never have been undertaken, had not this channel been open to their authors. It would be foreign to my purpose, even were it possible, to give you an account of the philosophical societies which have flourished, not merely in Europe, but in some of the most distant regions which her sons have reached as colonists or conquerors. A description of them would fill volumes—a record of their proceedings would be the history of scientific progress for the last two centuries—I might say of science itself; for, in fact, they began with Newton, and he stands like the sun in heaven—all is luminous after he has risen, all before darkness or twilight. Yet, while rendering to them the praise which their services have so well deserved, we must not forget, that as they were called into existence to meet a state of things which has passed away, so the altered condition of the human mind requires from them now a very different class of function from those which they discharged at first, and that circumstances may occur in which they may retard instead of advancing the progress of knowledge. That which I referred to as an original element of their power is of this number; their restricted and local character—their very nature requires that they be placed in large towns or cities; and they cannot multiply their members beyond narrow limits. This was not injurious as long as a single room in a tavern was sufficient to hold all the philosophers of the metropolis, or the means of experiment and instruction were scarcely accessible out of its precincts. It is far otherwise now—when we count more thousands, and those, too, of higher standard in the ranks of science, than units could be reckoned at the beginning of last century, and when every day adds to their number. No possible extension of the great societies can meet this, even were they disposed to make it, which, I believe, they are not. On the contrary, there is among them a tendency to limit their admissions to men of high fame and proved attainments, and thus, in some degree, form an aristocracy of science. What, then, is to become of the rest? Are they to form provincial societies similarly organized? This, it seems to me, is but a retrograde step—a violation of the great principle to which we owe our advance—a breaking up into fragments of the energy which every effort should be made to associate into one mighty unity; and however valuable such societies are as auxiliaries, unless it be found possible to link them by some principle of federation unto our great body, without interfering with their self-government and independence, I feel that much of the good which they are capable of effecting must be lost. Secondly, the increasing vastness of the field which we have to cultivate surpasses the powers of any single body of labourers. Look, for instance, at the most illustrious of all—the Royal Society. At first, as we see from its *Transactions*, it was a mere collector of detached facts and observations, and for them took even a wider range than is attempted by all our Sections; it collected, too, with little discrimination—in that dawning of information it was not always possible to distinguish a pebble from a pearl. It soon, however, became fastidious; for it reached the point when it became more important to class and interpret than to collect, and the latter part of its office became subordinate to the other. By degrees, as its accumulating duties began to surpass its powers, we find dissatisfaction appearing, and complaints that particular branches of science are neglected to favour others not so important. At last, the necessity of a division of work becomes apparent; a society splits off to devote itself to geology, another to astronomy, others to various branches of natural history, while the parent, like Trembley's hydra, is more active and powerful than before this division. That this process has increased our knowledge a hundredfold will not be disputed by any who have watched its progress during the last thirty years; and yet it can scarcely be denied that, besides the chance of exciting hostile feelings between rival societies, it is open to another objection. The different branches of science cannot well be isolated, each depends on many others. Geology presses into its service, not merely its special subject, but also the geometry of Hopkins, the botany of Lindley, and the zoography of Owen and Agassiz. Astronomy must not only track the unseen with Adams and Leverrier, or fathom the abysses of the sky with Herschel and Rosse, it must also visit the workshops of the machinist with Airy and Struve. And so of the rest—they cannot be disunited; and therefore it is evident that some system must be found which, while it leaves unfettered the whole special organization of each society, shall yet combine their exertions, not merely with each other, but also with the great and ever-increasing multitude of fellow-labourers beyond their precincts. Therefore it was not merely a happy thought of the good and wise men who were the founders of the British Association which led to its existence; this, or something equivalent, was a necessary result of the expansion of that principle whose course I have been tracing, and which must, ere long, have found some other development had they not turned it in this direction. It leaves untouched all that was previously available, and merely adds what experience had shown to be deficient. Thus we do not interfere in any way with any society; on the contrary, we identify ourselves with them as far as possible. We admit, *as of right*, the members of all chartered societies that publish transactions throughout our empire; the officers and councils of philosophical institutions, and all their members who are recommended by those councils; and our governing power, or general committee, is almost entirely derived from the same source—it is chiefly composed of "members who have printed papers in the transactions of any philosophical society, or of delegates from such societies or philosophical institutions." We withdraw nothing from their transactions—our reports are of a totally different character; we, on the contrary, assist them—for many of the most valuable communications which those publications contain in latter years have originated in the proceedings of our Sections. Yet, though we have so much in common with them, it would be a gross error to confound us with them, or to imagine that any increase of their activity, or any change in their management, could supersede our office. Not the least important part of it refers to persons entirely unconnected with them, persons who have struggled after knowledge in difficulty and obscurity, whose diffidence would shrink from the distinction belonging to such connection—or even who, without any scientific acquirements, have yet a reverence for them, a perception of their worth. Such we can count by thousands; and every one of them, I am confident, has been profited by the influence which we have exerted on his mind. We have gone still further, and admitted ladies as associates—exciting the surprise and perhaps scorn of those who think women fit only for household cares or showy accomplishments: and we have done well—for without referring to Mrs. Somerville, Mrs. Marcet, or others whom I would name were they not present, I have myself known some whose proficiency in several of our departments might have put many an F.R.S. to shame, who were not to be surpassed in all the graces of their sex, and were perfect in all the relations of domestic life. Man cannot ascend in the scale of intellectual power unless woman rises with him. Another advantage which we possess above stationary societies is, our mobility; we can pursue our labours wherever much is to be learned, or many are to be taught. From the universities, the seats of abstract science, we have ranged to the mighty emporia of Great Britain—to the treasure-houses of its mineral and metallurgic wealth—to the marvellous palaces of its industrial art; and at every step of our progress, even the most highly-gifted and richly-stored among us have learned new facts, seen opening before them new lines of thought, and met new men. It is a glorious discipline—the very one which Homer attributes to the wisest of his heroes: πολλων ανθρωπων ιδεναστεα και νοον εγνω. And let us hope, that, in the expressive imagery of the New Atlantis, we also may be "dowery men" and "merchants of light;" that they whose seats become the marts of our intellectual commerce may receive in it their share of the illumination which we seek; and that, by imparting to them new ideas—by correcting error—by opening to them more fully the laws which rule those elemental powers that serve them in works of microscopic beauty or giant might—we may endow them with gifts which shall both increase the reward of their own industry and enterprise, and augment the prosperity and glory of our country.

Our Association has been tried during eighteen years, and with a success which has exceeded by far what its most ardent friends had ventured to anticipate. It would, of course, be unreasonable to expect that its career should be at all times equally brilliant, or that an institution whose roots spread into every part of the realm and every order of its people, can be free from the fluctuations by which their prosperity is ruffled. It must also be borne in mind, that if we adhere, as I trust we ever shall do, to our rule of assembling wherever we are called by the interests of science, we must occasionally visit remote and unattractive localities, where the difficulty of access and the want of accommodation will discourage many from attending. But yet we can truly assert, that in *each* of these eighteen years—and assuredly this nineteenth will be no exception—it has added largely to our knowledge, and in no respect fallen short of the objects contemplated by its founders. These were, as stated to the original meeting at York, "to promote the intercourse of the cultivators of science with each other, and with foreign philosophers,"—"to give a stronger impulse and more systematic direction to scientific inquiry,"—"to obtain a greater degree of national attention to the objects of science, and a removal of the disadvantages which impede its progress." Let me request your attention for a few moments respecting each of these. The first of them may perhaps be undervalued by some, or rated merely as an intellectual luxury. Even at that low estimate it is above price; but it is of far higher import. If to visit the field of some high deed—to stand before the sepulchre of the illustrious dead—can fill the mind with lofty aspirations, and lift it to noblest emprise, how much more shall it kindle in the actual presence of one of those great beings who are raised up by our heavenly Father to be the lights of our race! Who could stand before Bessel without feeling how genius is exalted by industry! What a lesson of truth and decision was written on the brow of Dalton! But our close intercourse with each other is still more precious, from its tendency to check some evil elements of our nature. For instance, the bitter disputations and petty hostility which have too often disgraced the records of science, and made its followers contemptible. The most irritable man must feel less disposed to apply violent language or attribute unworthy motives to one whom he has met in kindly intercourse, and whose character he has appreciated, than when he encounters a perfect stranger in the arena of the press; or if he have offended, how many opportunities of atonement and reconciliation are offered by a re-union like this! Accordingly, this fault has nearly disappeared; and when traces of it occur, it is only in persons who have not fully entered into the spirit of our Association. Nor is it less powerful to avert a still greater danger—the greatest, in fact, which besets our pursuits—that of self-esteem. The true philosopher does not incur it: he knows too well the proportion between his ignorance and his knowledge; but if there be any who, from being the wonder of a limited circle, or from exaggerating the difficulty of his own attainments, is disposed to exalt himself above his peers, let him visit us, and I will answer for his cure. There is not a man on earth who could try the experiment without finding superiors in some of our departments, and scarcely any who would not find an equal in that of which he is vain. As to our foreign visitors, I need not take the trouble of proving what you all feel: the attracting them to our shores—the having the opportunity of knowing such men as Arago and Oersted, Ritter, Encke, Struve, Bache, or Henry—of strengthening by the ties of friendship that brotherhood of science to which I have already referred as of such importance—that alone would be worth an association to obtain it. Even on this, the first night of our meeting, we are honoured by several distinguished guests. On another occasion I shall express to them our acknowledgment of the honour with which their presence graces us; but now shall refer only to one—the Chevalier Bunsen—in answer to any who may suppose that an attachment to any of the various branches of science in which he is so highly gifted, unfit a man for the most energetic discharge of the active duties of public life. In the second object —"to give a stronger impulse and more systematic direction to scientific inquiry"—we have not been less successful. The very excitement connected with our meetings is itself such an impulse, and a most powerful one. Those of our members who have long been known as the chief ornaments of our great philosophical societies—devoted to science, and rich in its triumphs—feel it as fully now, as when first they joined us. At each new occurrence they seem to find a renovation of enthusiasm—a flow of hope, an increase of resolution among us—which send them with fresh strength to resume their labours; and will be present to them in the hours of despondency and gloom, which at times cloud even the firmest spirits, like a beam of light. Nor is our spell less potent on those yet untried in the race, who come forward to communicate the first fruits of their research,—the truth which has rewarded their solitary toil. To such, the approbation, the kind advice, the affectionate warning of their more renowned companions, is like a horoscope that stamps the future course of life, more powerful even than the applause of the multitude who rejoice at the success of one unknown, and are encouraged by it to similar exertion. But still more precious is the excitement of plunging into this mighty flow of intellect, to one whose lot is, like mine, cast remote from the resorts of science,—few or none near him to understand or value his pursuits,—nothing but his own fixity of resolve to disperse the listlessness which thus gathers on the mind and clogs its wing. To him you are as an oasis to the travellers in the desert, whose palms and fountains make him forget the waste he has left, and store him for another journey with the means of life. But we not only give this impulse, we also guide it, and, by guiding it, sustain and increase its strength, as well as by removing the difficulties which resist it. A small part of what we have thus accomplished you find in the volumes which we have published; the most important, as I already stated, is to be found in the transactions of various societies, or in separate works. Let me select a few instances for rapid notice, as time will fail for more. To begin with the science to which I myself am specially devoted—Astronomy: it has been above all others patronized by nations and individuals; in our own country a society of high fame and influence has been established for its advancement, and yet it has remained for us to render it services of no common order, which I may be permitted to explain in some detail. In it, as in many other of the physical sciences, the observation of facts is merely the crude ore, which must be sorted and sifted and passed through the furnace, to make it yield the metal which we seek. The mere task of making the observations is generally a pleasure, but it is far otherwise with the subsequent process. The arithmetical operations which it requires demand much more time, and involve much more labour,—that, too, rather intellectual, and involving at every step liabilities to error. Take a simple instance: you have determined with minute precision the apparent place of a star in the sky,—if you stop then, you have done nothing. The place you have obtained is not the true one, the atmosphere has bent the line of sight; while the light travels down your telescope, you and it have been moving, and the sky-marks by which you map the star are themselves disturbed by various and complicated motions. For all these you must allow; but to do so requires, on an average, even in the most improved method of modern times, the writing of 400 figures, and the performance of 50 arithmetical operations. But the numbers themselves employed are the result of other complicated operations; nearly half are constant for the same star, but an equal number have relation to the sun and moon, and therefore vary from day to day. Were these also to be calculated, it would add an equal amount of work. But even this is insufficient, for we must compare what we thus obtain with the results of former astronomers; and this also cannot be done without bringing them together by the same arithmetic talisman; so that were the whole to be performed by the one calculator, I have found that, however expert he may be, he must expend an hour at least in obtaining each result. Now, from most of this drudgery in the case of more than 8,000 stars, he is relieved by the Catalogue which the Association has given to the world. It contains for each the constants already noticed; and gives the prompt and easy means of making the comparison,—so easy, that probably before its epoch 1850 is past, every one of those places will have been verified in the sky. Such an undertaking could have been effected only by such a power as ours, which could at once engage the services of such men as Baily, Herschel, Stratford, and their fellow-labourers, and devote to the inferior part of the work an expenditure exceeding £2,000. In fact, had we done nothing else, I say fearlessly, that this work alone would have secured us an enduring claim on the gratitude of science. Let me here remark, that there are many other departments in which we could render most important service by the mere collection of the constants that belong to them, as we have done in this case, and in that of terrestrial magnetism. Constants are the framework of knowledge, the concentration of power: they belong peculiarly to our domain, and were marked out as such long since; but though unfortunately this work was not executed by that powerful mind to whom we intrusted it, I hope the subject will not be forgotten. I might tell you of the theory of the tides, which Laplace might well style "the most thorny of problems," but of the greatest interest to a nation "whose march is o'er the mountain wave, whose home is on the deep." I might tell you of light thrown on it by observations obtained by our influence, reduced at our expense, and unravelled by one worthy of going beyond the steps of Newton and Bernouilli. To the same philosopher we owe the execution of another important task,—the determination of the plane which marks the level of the sea, unvarying with the changes of the tide; a precious gift, as but for it in a few years the absolute levels of our great national surveys would have become a delusion. In Ireland, for example, they referred to the low water of spring tides; a mark which could not be recovered, as it varies both with time and place. I know not whether this has been yet corrected, but I trust it soon will, as Airy's observations afford the data. It would be tedious to tell you all of this kind that we have effected: and I leave the subject, with a reference to one more example,—the investigation of the motion and nature of waves, which we owe to Mr. Scott Russell. These lead, by an unexpected line, to one far more interesting in a practical view,—the resistance and the form of ships. On this subject it appears that valuable information has been collected for us; and it cannot but be matter of regret, that materials obtained at so great an expenditure of money (more than £1,000), of labour and thought, should remain unavailable, especially considering the present imperfect condition of naval architecture in reference to science. In many instances we have aided inquiries of inestimable value, though we did not originate them,—as the Fossil Ichthyology of Agassiz, and those of Owen on Fossil Reptiles and Mammalia, which perhaps but for us would never have been completed; and, in fine, I may mention, as an approximative measure of the impulse which we have given to science, that we have expended in this way £15,000. Observe, too, that to this must be added whatever is the pecuniary value of the labours of those members of the Association who have given us their services. *That*, all is gratuitous; and if you consider who many of them are, you will find it not easy to assign its price. But I regard as even more conducive to the advancement of science, another part of our labours, peculiarly our own; I mean the reports which place before us the actual boundaries of our knowledge. Much intellectual energy is wasted in inventing what is already known; much spent on objects comparatively unimportant for want of a due estimate of their worth; many walks untrodden, because it is supposed they have been sufficiently explored. For all this a remedy is found in those admirable surveys, so many of which are found in our volumes; they are, as it were, a "taking stock" of our intellectual wealth, and tell us how much of it is real, how much doubtful, how much wanting. Whether we consider those which embrace a whole science, as those of Airy on Astronomy, or Forbes on Meteorology,—or those which include some one of its divisions, as those of Sabine on Terrestrial Magnetism, Lloyd on Physical Optics, Rennie on Hydraulics, those by the Dean of Ely and his compeers on parts of Mathematical Analysis, or those of Owen and his fellow-labourers in Natural History,—with a multitude of others,—it is scarcely possible to over-estimate their worth. You find there condensed into a few pages the essence of many volumes; the chaos of clashing statements and conflicting opinions reduced to harmony and order; truth winnowed from error, facts from conjecture. They place within the reach of the most secluded student a treasure of certain information, which it would be hard for him to obtain even had he access to the libraries and institutions of the metropolis; and even to the mind that is best stored they save time,—and time is power. Such reports we shall, I trust, continue to receive in increasing numbers; and as long as we do, we prosper,—for they are the surest index, though not the most showy, of our usefulness.[*]

THE MECHANIC'S LIBRARY.

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RECENT PATENTS.

MANUFACTURE OF GLASS AND ALKALIES.—W. H. Balmain *and* E. A. Parnell, *St. Helen's.—Enrolled 5th September*, 1849.

The subject of this patent is divided into five sections—the first relating to the formation of the single and double silicates of soda, potash, and barytes, by heating the sulphate of the bases with sand and carbonaceous matter. To understand this part of the patent, it will be necessary to remind the general reader, that the sulphates of the bases are employed in glass-making, on account of their comparative cheapness, but require the addition of carbonaceous matter to decompose them, and are subject to curious and almost uncontrollable evil caprices in the hands of even the most skilful manipulators. These uncertainties the patentees hope to remove by this portion of their invention. A silicate containing either 12 or 20 per cent. of soda, or an equivalent per centage of other bases, is formed by heating suitable quantities of sand, sulphate of soda in fine powder, and charcoal. The product is thrown into water, which dissolves out the undecomposed sulphates, and the silicate is then mixed with lead, lime, sand, &c., according to the manufacturer's views, and is remelted for use in the ordinary glass-house pots. The result of the two operations is said to be a finer quality of glass than can be produced at one operation, whilst the uncertainties of the old method are removed.

Secondly, the patentees propose the use of sulphurets, or hyposulphites, as deoxidising agents, in place of charcoal or carbonaceous matter—half an equivalent of a sulphuret, or one equivalent of a hyposulphite, being necessary to replace one equivalent of charcoal. The advantages supposed to arise from this substitution, are the diminished evolution of gas in the formation of the glass, and the possibility of employing a substance of small value—such as the impure sulphuret of calcium, formed in the dry lime purifiers of the gas-works, the refuse of the soda or soap manufactories, &c.,—in place of the more costly wood-charcoal which is usually employed for the purpose; or a sulphuret of sodium may be advantageously made for this particular process, by heating any carbonaceous matter with sulphate of soda, and separating the carbonate of soda, which is formed simultaneously by the process described in a subsequent part of the specification.

The patentees' improvements relate, in the third place, to a furnace of peculiar construction, and specially adapted to the manufacture of the silicates and sulphurets referred to. It consists of an ordinary reverberatory furnace, the bed being inclined to the fire. Upon these beds a charge of about 20 to 25 lbs. of the mixture is introduced through a suitable aperture in the roof, and spread evenly by an iron rod. As the materials melt, they flow towards the grate-room, and through an aperture left open for the purpose, into water, if required for remelting, or into a pot, if the proportions of the ingredients are such as to produce a glass fit for immediate use. When the pot is full, the metal is allowed to fine; and by having two pots side by side, with suitable apertures in the furnace capable of being closed or opened at pleasure, each pot can be filled, fined, and worked consecutively, and the process may be in this manner rendered continuous. But when the product is a sulphuret or alkali, it is simply allowed to run into any convenient box or mould of iron.

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[*] We shall give the concluding portion of the address next month.

The fourth part of the invention relates to a process for preparing silicate of soda, by acting on a mixture of sand and common salt, chloride of sodium, with sulphurous acid and air, assisted by heat and carbonaceous matter; and to the preparing of sulphate of soda in a fit state for making glass or alkali, by acting upon common salt, with or without sand, with air and sulphurous acid gas, aided by heat. For this purpose, three parts of sand and one of salt are mixed together, and well damped, so that the mixture will cohere together in drying. When quite dry, the mass is broken into moderate-sized pieces, which are placed in an upright flue, or kiln, having an aperture at the top to introduce the material, and another at the bottom to remove it. The upper part of the flue opens into a chimney, or other source of draft, and the sulphurous acid gas and hot air are admitted at the bottom. The process of conversion takes place at a low red heat, but the temperature may be advantageously raised above this point; and it is in order to preserve the porosity of the lumps at a temperature which would melt the salt, but at which the process proceeds with the greatest advantage and rapidity, that the patentees recommend the addition of sand or *any other inert body*, they being fully aware that the use of oxide of iron for the same purpose has already been made the subject-matter of a previous patent; but they have ascertained that the addition of any *chemical agent* is not necessary to the success of the operation, the only advantage arising from the addition of sand, or any inactive body, being in maintaining the porosity of the mass, and thus presenting a larger surface of salt to the action of the sulphurous acid gas and air. As the lumps at the bottom of the flue become decomposed they are removed, and new matter is added at the top; thus the process is rendered continuous. When the result required is a silicate of soda, the fining and the admission of air must be so regulated that the gaseous products shall be alternately oxidising from excess of air, and deoxidising from the presence of unburnt carbon; in this case, sulphate is produced during the first period, and decomposed and converted into silicate during the second period. When it is not desirable to produce a silicate at once, but a mixture of sand and sulphate, to be afterwards converted into glass, or else lixiviated with the object of using the sulphate of soda in alkali-making, the fining and admission of air should be so managed as to insure the constant presence of air in excess.

The supposed advantage of this process will arise from the facility which it presents for the application of sulphurous acid gas when so mixed with air, carbonic acid, and other gases, as to be unfit for conversion into sulphuric acid in the leaden chamber by the usual process. Thus the sulphurous acid disengaged in the production of a glass or silicate from a sulphate in an open furnace, and that disengaged in the roasting of metallic sulphurets previous to the ore being roasted, may be advantageously rendered available.

Lastly, the patentees' improvements relate to the separation of the carbonate of soda, which is produced during the decomposition of the sulphate of soda in the process for making sulphuret of sodium, as described in the second part of these improvements. The mass resulting from the heating together of sulphate of soda and carbonaceous matter is dissolved in water, and, being allowed to stand, the clear liquor is drawn off the very small amount of impurities which will have subsided. The liquor is then boiled down in a salting-down pan placed over the fire, and the process is continued as long as any deposit takes place, the salts so formed being fished out in the usual way, and set to drain; they are then washed in some of the weak clear sulphuret liquor, and are dried in an ordinary finishing furnace. The presence of so much sulphuret of sodium in the liquor, prevents the adhesion of the carbonate of soda to the sides of the pan, and thus the fire can be economically placed below, instead of playing over the surface of the liquor, as in the ordinary process of salting down.

In conclusion, the patentees claim,—

1st. The preparation of silicate of soda, silicate of potash, and silicate of barytes, and the double silicates of these bases, by heating their respective sulphates with sand and carbonaceous matter.

2d. The use of a sulphuret or hyposulphite in the place of carbonaceous matter in making silicates, and in place of charcoal, as heretofore used in making glass by means of a sulphate.

3d. The use, in glass and alkali making, of a furnace of the peculiar construction above described, whereby the removal, without labour, of each portion of the material from the sphere of action, is effected as soon as the heat has caused the requisite decomposition and combination; the product being caused to flow by its own weight either altogether out of the furnace, or into an attached reservoir or pot.

4th. The preparation of a silicate of soda, by exposing a heated mixture of sand and common salt, first to the action of air and sulphurous acid, and afterwards to carbonaceons matter or other deoxidising agent; and also the preparation of sulphate of soda, in a fit state for glass or alkali-making, by exposing salt, or a mixture of salt with sand or other inert substance, to the united action of heat, air, and sulphurous acid. And,

5th. The separation of the carbonate of soda from the mixture of carbonate of soda and sulphuret of sodium, produced during the decomposition of sulphate of soda by carbonaceous matter.

SMELTING COPPER.—F. H. Thomson, M.D., *Glasgow*.

Enrolled September 24, 1849.

This invention consists in the application of what are commonly called whinstones, and also of iron slag—which partakes much of the nature of whinstone—and also of other stones similar to whinstone; such as trap, basalt, sienite, and the like, being fusible silicates, as a flux in the smelting of copper ores, whether such ores are in the state of sulphurets, carbonates, or oxides. The process employed by the patentee is as follows:—If the ore is a sulphuret, containing 20 per cent. or upwards of copper, and the quantity 1 ton, which has been previously calcined in the usual way, it is placed in a reverberatory furnace, as is now generally used in smelting copper, and to it is added 4 cwt. of whinstone, broken into small fragments, and 70 lbs. weight of pulverized coke. By this mixture, an excellent and cheap flux is produced, and the highest amount of copper is obtained. To improve the process, the patentee adds barilla to the mixture; and when this addition is made, the quantity of whinstone may be diminished in the following proportion—that is to say, if 37 lbs. of barilla be used when the ore contains 20 per cent. or upwards of copper, then 2 cwt. of whinstone to the ton of ore will be sufficient.

When a carbonate or oxide ore, containing 20 per cent. or upwards of copper, is treated, the same quantities of whinstone and coke may be used; but 56 lbs. of limestone, and 20 lbs. of oxide of iron, are added, in order to produce the result required; and, in all cases, if the ore, of whichever kind it may be, contains less than 20 per cent. of copper, then the patentee's rule is to use about one-third less of the whinstone. He also states that the application of barilla is equally as advantageous here as in the former case; and if it is used in smelting the carbonate or oxide ores, then the limestone and oxide of iron may be diminished by about one-half, and the process becomes the same in other respects as that adopted with reference to the sulphuret ores, with the exception only of their not requiring to be previously calcined.

Although only whinstone, coke, oxide of iron, limestone, and barilla, have been mentioned as the ingredients employed, it is evident that, as the slags produced from blast furnaces in the ordinary process of smelting iron, and commonly called iron slags, partake of the nature of whinstone, as regards the ingredients of which they are composed, and are equally inexpensive to procure, they are found to answer the purpose, and may be used in the same proportions as whinstone, as also the stones called trap, sienite, basalt, and some others; and although coke is described as being used, where the object is simply to add carbon to the mixture, charcoal or anthracite coal would answer the same end. Where oxide of iron is described, it is evident that calcined black-band ironstone or carbonate of iron will do equally as well; as also where barilla is mentioned, ordinary kelp may be used. But as these several articles, in their varieties and numerous combinations, might require a great variety of proportions in their admixture, the patentee has named such substances only as in his own experience he has found best to answer the intended end, and the best proportions of which he has ascertained; but as the spirit of his invention being the application of cheap and abundant natural fusible silicates, or substances containing the ingredients required as a flux in the smelting of copper ore, instead of using the ingredients in a more costly state, or separated from their natural matrices,—and, in order to accomplish which in the best manner, he has found it useful to add to the said natural fusible silicates other classes of matters, of which there are numerous varieties,—he has only deemed it necessary to describe or name one in each class in detailing the processes employed.

The claim is—The smelting of copper ores by the use of what is commonly called whinstone or other like stones, broken into fragments, as a flux; or by the use of what is commonly called iron slag,—all having carbon added, and either with or without alkali, as an improved flux.

Disclaimer proposed to be entered by the said Francis Hay Thomson with the Clerk of the Patents of England, pursuant to an Act passed in the fifth and sixth years of the reign of His late Majesty King William the Fourth, intituled, "An Act to amend the law touching letters patent for inventions."

"I, the said Francis Hay Thomson, do declare that, since I obtained the said letters patent, I have discovered that part of the invention which was intended to have been described under that part of the title which is contained in the following words, "or other," is not of such practical utility as would make it desirable to retain it; for which reason, I am desirous to, and do hereby, disclaim all that part of the title which is contained in the following words, "or other," so that the title of the invention may remain thus" "an improvement, or improvements, in smelting copper ores."

LOCOMOTIVE ENGINES.—Walter Neilson, *Glasgow.*

Enrolled September 27, 1849.

The improvements embodied in this patent have reference to locomotives, where it is not intended to employ a tender. Several varieties of engines of the tank class have already been introduced for this purpose; but the present arrangement differs from all predecessors in the greater compactness attained in the combination of the various parts. Our engravings represent, respectively, a side elevation and plan of Mr. Neilson's engine, with the tank and coke-boxes clearly illustrated. In place of employing a separate tender with tank sides to contain the water supply, a species of saddle-shaped tank, A A, is used. This is made of a length equal to that of the whole barrel of the boiler, to the curvature of which its interior is formed. It rests upon the framing of the engine, to which it is bolted, being only separated from it by the intervening thickness of the cleading. In place of forming a separate smoke-box, the front end of the tank is made to answer for it, and thus it is completely surrounded by water. The tank may be supported from the boiler, instead of the framing, if necessary, and its length may be made shorter than that of the boiler if required.

Fig. 1.

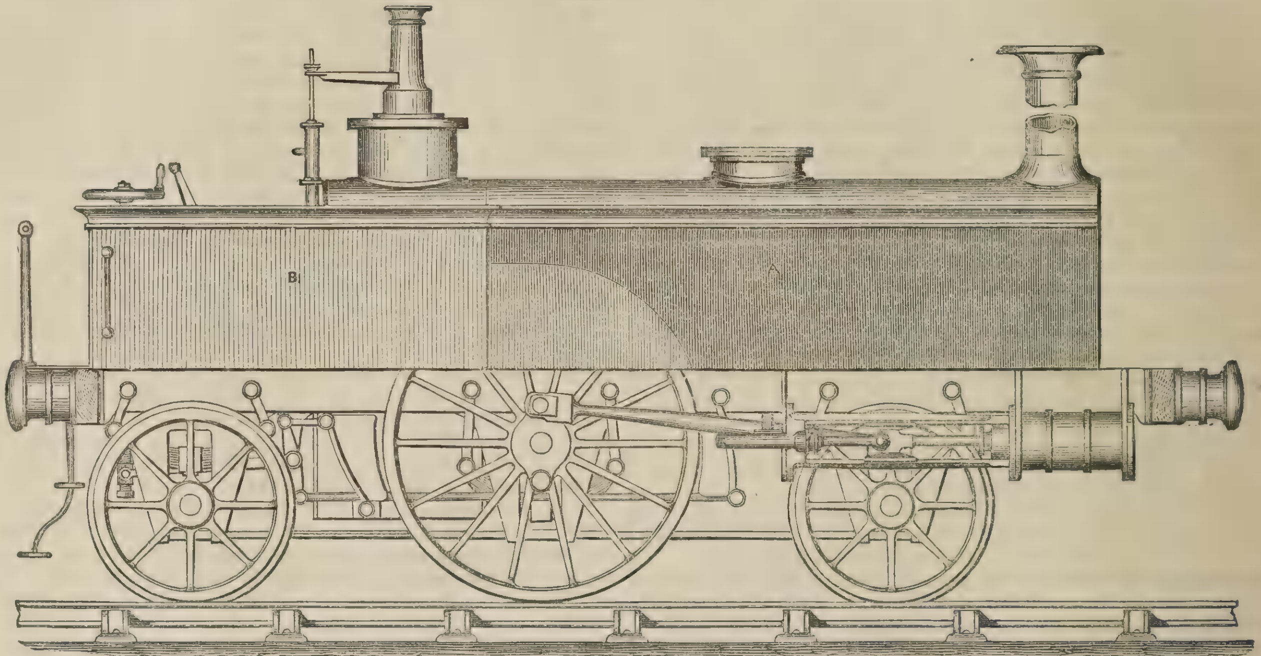
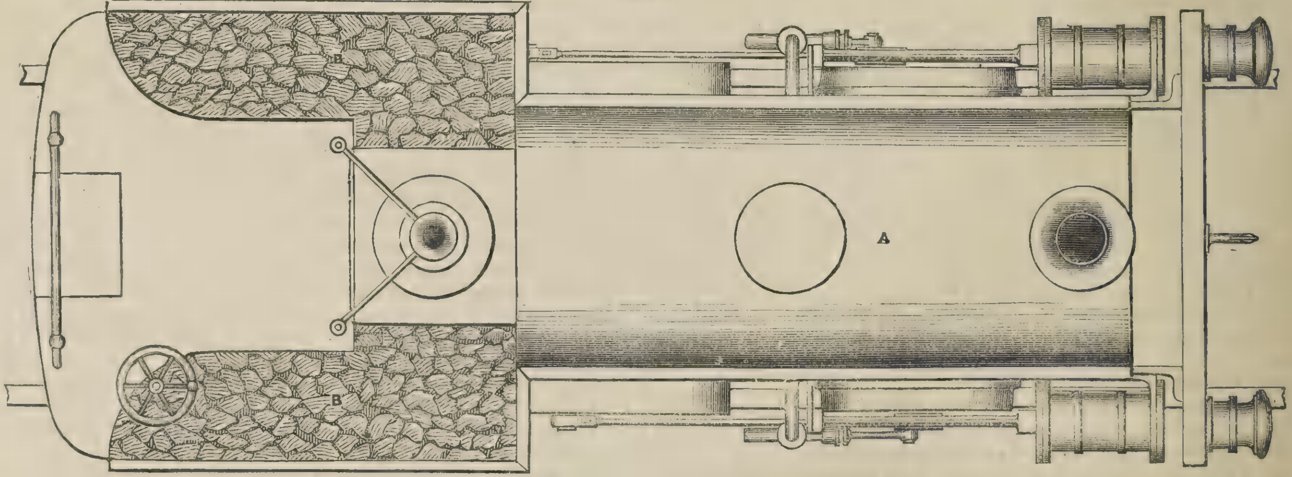


Fig. 2.



From the simplicity of this arrangement, the water-tank can be unshipped from its place in a few minutes, and again replaced after examination or repair. A modification is also introduced in the feed-water arrangement, so that the water is made to pass to the smoke-box end of the tank, where it takes up the waste heat previous to its entering into the boiler.

Another point worthy of attention is, that the position of the tank enables the feed-pumps to work with more security than when there is no head of water above them. The coke-boxes are at B B, one on each side of the fire-box, on the driver's foot-plate, leaving free space for the driver and fireman, and allowing of ready access to the couplings with the waggons behind.

The claims are—the arrangement of the water-tank and the coke-boxes.

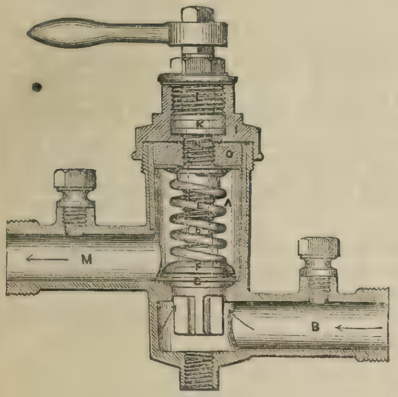
REGISTERED DESIGNS.

WATER-PRESSURE REGULATOR.

Registered for Mr. D. Burges, *Brassfounder, Glasgow.*

This instrument has for its object the regulation of the superfluous head pressure of water in the service-pipes of water-works, whereby any high initial pressure may be reduced down to that which is merely sufficient to convey it to the elevation where it is required for use; and in accomplishing this, it answers an end, to the attainment of which we can scarcely attach too much importance. Whenever water supplies are obtained from sources of great elevation, several objectionable features present themselves in the working machinery. Amongst these are noise, liability to fracture the pipes, and the disagreeables attending the powerful rush of the fluid when drawn off.

Our engraving exhibits a vertical section of the ingenious and effective apparatus, introduced by Mr. Burgess as the antidote to these evils. In external appearance it differs little from an ordinary stop-cock, with the usual receiving and discharging branches. A, Is the barrel or receiver of the water, which is conveyed into it by the branch, B, communicating with the main pipe. C, Is a valve in the interior of the barrel, opening upwards. It is carried by a vertical spindle, D, which is surrounded by a helical spring, E, of unannealed brass wire, and has a metal disc, F F, at top and bottom. The lower disc bears upon the upper surface of the valve, C, whilst the upper one abuts against an adjustable disc, G, which is screwed upon the adjusting spindle, H, passing out through the cover, I, of the shell. This spindle has a shoulder at K, fitting by a packing piece on its upper and lower surfaces, between the bottom of a recess in the cover, I, and the lid, L, of the cover. This shoulder prevents any longitudinal movement of the spindle when it is turned, whilst the action of the screw-threads upon the latter causes the disc, G, to ascend or descend, according to the movement required, as it is prevented from moving with the spindle by two feathers fitting into grooves in the interior of the barrel. The lower portion of the spindle, H, is bored out to receive the top of the valve-spindle, D, as a guide. The arrows point out the passage of the water, which enters at B, and tends to raise the valve, C, with a pressure equal to its effective head; but the opposing pressure of the spring, E, which may be increased or diminished, as before explained, re-acts upon the water; and the latter issues by the branch, M, with a pressure equal only to the amount occasioned by the difference between the pressure of the spring on the top of the valves, and that of the water beneath it. To provide an easy means of ascertaining the pressure of the water both before and after it is acted upon by the regulator, screw-plugs are fitted on each branch of the barrel, for the attaching of indicating tubes, to show the height of water column.



1-3d.

The whole of the design is registered as new.

The mains of the Gorbals Gravitation Water Company here, have afforded an excellent test for this instrument; and Mr. Gale, the engineer of the works, has expressed his approval of its action under various pressures.

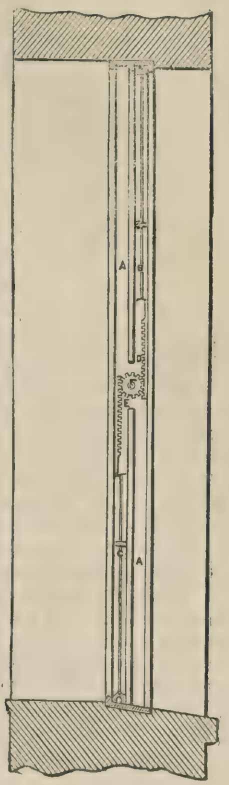
The effective control which it exercises over the most excessive pressures, must recommend it to the notice of all house proprietors where the head of water is high, as it dispenses with the present necessity of inordinately strong service-pipes, by removing the strain and disagreeable shock now so frequently felt in houses deriving their water supply from an elevated source.

The pipes of a whole range of houses may be readily governed by a single regulator, placed at the junction of the main service-pipe with the main itself; and in this way the pressure of the supply for each house can be reduced to the lowest delivering level.

MELLING'S DOUBLE SASH-WINDOW SUSPENDER.

Registered for T. Melling Esq., *Rainhill Iron Works, Liverpool.*

Mr. Melling's ingenious design has for its object the suspension of the two sashes of windows in such a manner that one shall balance the other, by the substitution of a simple mechanical arrangement, which entirely dispenses with all cords, pulleys, and weights. The movement is accomplished by attaching, on each side of both sashes, a short toothed rack; between each pair of which, a small pinion is set, gearing with both. The engraving annexed, representing a vertical section through the centre of a window, exhibits the construction of the whole details. A A, Is the frame in which the upper and lower sashes, B and C, slide; D and E, are the toothed racks, placed one on each side of the top and bottom, respectively, of the upper and lower sashes, and gearing, back and front, with the small brass pinions, F, running on studs set in the fixed side-frames of the window. Thus, if the lower sash is elevated, the upper one is, by the same movement, lowered to a corresponding extent; the motion of either sash producing a corresponding opposite one in its partner: and as they are equal in weight, a perfect balance is kept up between the two, without the usual troublesome apparatus of cords and weights.



The length of the racks, and consequently the extent of opening of the window, can be made to suit any particular locality or purpose.

For the windows of prisons and lunatic asylums, this suspender is peculiarly applicable, as, by shortening the length of the racks, the travel of the sashes may be limited to any given distance; and whilst the ventilation of the apartments is secured, the small amount of opening allowed, does away with the facilities of escape common to sashes of the usual construction. The householder will also find that, by the adoption of this movement, the annoyance consequent upon the breakage of cords and the sticking of weights will be avoided. There is yet one point to be remembered—that is, that one sash cannot be opened without the other, and this is sometimes needed. If this is a valid objection, it can, however, be easily removed, by a simple addition of a moveable slide to one or both sashes.

REVIEWS OF NEW BOOKS.

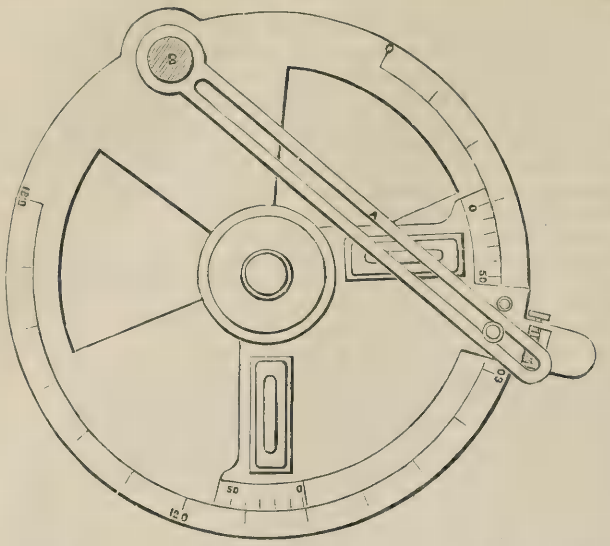
The Cyclograph: A New Instrument for Setting out Railway Curves. By Richard P. Williams, C.E. 4to. Pp. 14. Plates. London: Troughton & Simms. 1849.

Mr. Williams opens his subject with some pointed remarks on the existing systems of setting out railway curves, where he says—

> "The efficiency of those in most common use depends entirely upon the accuracy of the *plan*, and the absence of all error in the chainage on the ground, requiring, in fact, an exact correspondence between the position of the points in the plan with those on the ground. Should these requirements not be complied with, which very frequently happens, the curve, if set out from the incorrect plan, will necessarily be found unsuitable. The usual remedy in such cases is to find the proper curve by repeated trials, by which means not only is much valuable time lost, but often to no purpose, and ultimately the curve, from the absence of any practical and correct method of determining the suitable radius of curvature, is obliged to be 'forced in,' as it is termed, by patching together arcs of various radii. The increased friction, strain, and other bad effects arising from such unsuitable and ill-formed curves, I am inclined to think, is much greater than is generally imagined; the subject as yet has received but little of the attention it deserves, and when it is more thoroughly investigated, I have little doubt the result will prove it to have a very appreciable effect upon the wear and tear of locomotive power and rails."

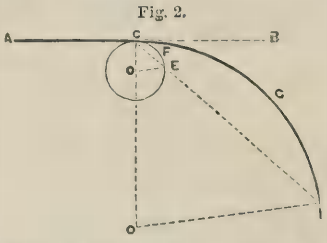
As an attempt to systematise the present irregular processes, the author proposes the use of what he terms a "Cyclograph," invented by himself. This instrument is shown in plan, in fig. 1, half-size. The radius of the circle, upon the circumference of which the divisions are described, is $2\frac{1}{2}$ inches, as the most convenient dimension, to allow the subdivisions to be distinguishable without the aid of a glass, whilst it is as portable as possible. This radius is divided into forty equal parts, making the whole circumference equal to 251,328 similar dimensions; and these are semi-divided on the plate by shorter lines, and decimally subdivided to fiftieths by a vernier, hundredths being estimated. The vernier-limb is moved over the circumference by the radius-arm, provided with clamps and tangent screws, for the measurement of minute distances; and to level the instrument, two levels are placed on the plane of the vernier-limb, at right angles to each other, so that by them, and by the parallel plate-screws, great accuracy may be obtained. A grooved limb, A, one extremity of which is fixed as a centre upon the periphery of the circle, marked by the divisions, is attached by a screw to the vernier-limb, so that any movement causes the former to traverse twice the angular distance of the latter—the one measuring the angle at the centre, the other at the circumference. Over the centre, B, is set a telescope, fitted with a diaphragm, having a vertical movement upon its transverse axis. It has the same horizontal motion, though not the same direction, as the grooved limb, the extremity of which carries the supporting pillar of the telescope, its direction being such, that when the vernier points to zero on the plate, the axis of the telescope is in a line with the same point.

Fig. 1.



The author explains additional modifications of his instrument, but the one we have described, assisted by the diagram, fig. 2, will probably answer our purpose of explanation. If two circles of different radii are tangent at the same point to the same straight line, a line at right angles to the tangent, or inclined to it at any angle, if produced so as to cut both peripheries, will intercept similar circumferences proportional to their radii, so that the lesser circle, divided into the same number of parts as the larger radius, a line drawn from the common tangent-point, through any division of the one, if produced, will intersect a similar division in the other circumference.

Fig. 2.



> “*Example.*—Let A B (fig. 2) be the tangent line, C the common tangent-point of two circles of different radii, C F E, C G D. Suppose the lesser circle, C F E, to be an exaggerated representation of the cyclograph, whose radius is 40 equal parts; C G D, a curve of a similar number of *chains* radius; the chord C D will intersect the same number of divisions on the plate of the cyclograph, as there are chains in the curve C G D.
>
> “*To set out a curve with the cyclograph,* the number of chains radius having been taken from the plan, or if such prove to be incorrect, calculated by a rule which I shall presently explain, and found, as we will suppose in this case, to correspond to that represented by the cyclograph.—The centre of motion of the grooved limb over which the telescope (fig. 1) is fixed, having been brought by means of a plumb-bob immediately over the tangent-point C (fig. 2), and the instrument accurately levelled, the telescope is brought into a line with the tangent C B, and the division the vernier rests upon (if not at zero) noted, the vernier is then moved through one chain division of the plate. The axis of the telescope is now in a line with the first chain-point in the curve. One extremity of a chain being fixed as a centre at the tangent-point C, the other end, to which a ranging-rod is held, is “pulled taut” in the direction of the tangent, and moved as a radius until the cross-hairs of the telescope intersect the ranging-rod, which fixes the first chain-point in the curve. The chain having been shifted one length, one extremity is fixed as before, the other moved in the same manner until the cross-hairs of the telescope, which has been traversed through another chain division of the plate, again coincide with the ranging-rod, which determines the second chain-point; and so on, proceeding with the rest.”

This illustration clearly shows the exactitude and simplicity of the arrangement. For the several additional cases furnished by the author, we must refer our readers to the book itself, which contains, further on, some notes on the “cyclograph applied to the theodolite,” with copious “addenda,” giving several practical cases for the application of the proposed system—and a “table of chords for chain divisions of the cyclograph, from 1 to 125 chains, the radius being 40, the circumference 251.328 chains.” Messrs. Troughton and Simms are the makers of the apparatus in its several varieties, views of which are given in the two additional plates of the work.

THE HAND-BOOK TO THE ISLAND OF PORTLAND. Pp. 60. Weymouth: J. Sherren, 1849.

This is a neat little work, devoted, as its title indicates, to a brief consideration of the interesting Isle of Portland, which is less known than it ought to be. Perhaps the pleasantly-written pages before us may serve to extend its reputation; for they furnish, in a very agreeable manner, details of a beautiful locality. Amongst other notes, we gather from it, that amongst other productions of the island, the Wild Arum grows in large quantities. This plant produces arrow-root and starch. It is, besides, employed in pastry; for its application to which purpose a housewife of the district, some time back, received a reward from the Society of Arts. On the subject of the lighthouses of the island, we may make a useful extract:—

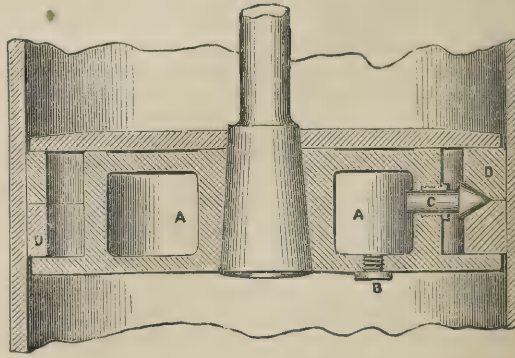
> “Pursuing the road, the tourist, at a mile and a half from the church, arrives at the lighthouses, which are within a quarter of a mile of each other, and so situated as to be visible at sea from nearly every point of the compass. The lighthouses are at the southern extremity of the island, called Portland Bill, and near a preventive station. The upper lighthouse was erected in 1817: its ground floor is 172 feet above the sea level; and the lamps are 25 feet from the ground. It contains two rows of Argand burners, with highly polished metal reflectors. In the lower lighthouse, a long winding staircase leads to the top, from which, on a clear day, Torbay may be seen in the west, and the Isle of Wight in the east—each distant from the spectator about 75 miles. This lighthouse is 20 feet in diameter at its base, decreasing to 10 feet at the lantern, and is 68 feet high. The lamps are 130 feet from the level of the sea; their power is increased by reflectors 22 inches in diameter; and the light is distinctly visible, until, from the distance, it sinks below the horizon.”

Some judicious remarks on the proposed Portland breakwater, and harbour of refuge, conclude the little volume, which we have pleasure in recommending to the notice of visitors to the neighbourhood.

CORRESPONDENCE.

PNEUMATIC PACKING FOR STEAM-ENGINES.

In your last Journal, Sept. 1st, 1849, I notice an account of a piston, invented by Mr. W. C. Moat, of Upper Berkeley Street, London, in which compressed air is used as a substitute for the metallic springs usually employed. I had, myself, a model made, some years ago, of a piston on this plan, but gave up the idea of it—1st, because I conceived there would be great practical difficulty in keeping so subtile a fluid as air perfectly tight; and 2d, because much difficulty existed in my mind as to the change which must necessarily take place in air, by its expansion when heated, as in the case of a steam-engine piston. This, it is to be feared, will be an effectual barrier to its general use for that purpose; especially when it is considered that air at 160°, which is about the temperature of steam at 10 lbs. per square inch, the pressure usual for condensing engines, is expanded about 1.275 times its own bulk, and of course still further as the temperature is increased.



The plan I had adopted was, perhaps, more simple in its construction than that proposed by your correspondent; but this may be judged from the sketch I annex, representing a vertical section of a piston fitted to its cylinder. The hollow of the piston, A A, itself answers as the reservoir for the compressed air, which is supplied to it from a pump by the plugged entrance at B. The elastic air-pressure is transmitted to the interior of the segments by the ram or piston, C, having a conical or wedge piece on its outer end, acting directly on the segments, D D.

The difficulty attending Mr. Moat's plan of piston would be very great, if it would not render it impracticable altogether. I fear this would be the case, but I should be sorry to throw any obstacle in the way of its introduction.

Bolton-le-Moors, Lancashire, JOHN HOWARD.
Sept. 3, 1849.

[In penning the notice of Mr. Moat's contrivance, last month, the objection our correspondent notices at once occurred to us; but if provision is, in the first instance, made for the amount of expansion due to the regular working steam pressure, it ought to work well. Of course this suggestion cannot be acted upon in cases where a great variety of steam pressures are used. Apart from this question, the present arrangement is simple, and appears to be highly effective.—ED. P. M. J.]

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF MECHANICAL ENGINEERS.—JULY 25.

ON A PNEUMATIC LIFT.

BY MR. BENJAMIN GIBBONS, OF SHUT END HOUSE, NEAR DUDLEY.

This pneumatic lift is employed to raise the ore coal and limestone for charging four smelting furnaces at Corbyn's Hall New Furnaces, near Dudley.

In some districts, the levels of the ground admit of the furnaces being charged by wheeling the materials on a level platform from higher ground to the top of the furnaces, but in general these have to be raised by machinery to the level of the top of the furnaces, the height raised being about 40 or 50 feet. The usual plan of raising the materials is by an inclined plane, which rises from the ground to the top of the furnaces at an angle of about 30 degrees; there are two lines of railway upon it, and a travelling platform on each line, drawn up by a steam-engine, by means of a chain passing over a pulley at the top of the inclined plane. The two platforms balance one another, one of them descending while the other ascends, and the top of each platform is made horizontal, and works level with the ground at the bottom, and with the stage at the top of the furnaces, so that the barrows of materials are readily wheeled on and off the platforms; several barrows are carried by each platform. A rack is fixed on the inclined plane along the centre of each line of railway, and a catch is fixed on the moving platform which falls into the teeth of the rack in ascending, for the purpose of stopping the platform, and preventing an accident in the case of the chain breaking; but the use of this catch is found to be inconvenient in practice, and is generally omitted. There is a difficulty in stopping the platform at the required level, and the inclined plane is objectionable from the space which it occupies, and the expense of its construction.

Where the inclined plane cannot be employed, the power of the steam-engine is not employed directly to draw up the materials vertically by a chain, because of the difficulty in working it conveniently and safely, to stop the platform at the correct level for wheeling the barrows on and off, and prevent the risk of serious accident by the chain breaking, particularly in night-work. At some iron-works an endless chain is used for this purpose, with a series of buckets fixed upon it, which are filled with the materials at the bottom, and empty themselves into the furnace by turning over at the top. This lift is not suitable for supplying more than one furnace; and when there is more than one furnace, it is most advantageous to employ a lift that will take up the materials in the barrows, ready for wheeling at the top to the different furnaces.

Another plan for lifting vertically is by means of a water-balance; the platform on which the barrows of materials are raised, is suspended by a chain passing over a pulley at the top, and a bucket is attached to the other end of the chain; the platform, in descending, draws up the empty bucket, and when the platform is loaded, the bucket is filled with water until it overbalances the loaded platform, and draws it up. There is an important objection to this plan,—that the bucket descends with an accelerated velocity, and a friction-break has to be used to check this velocity, and prevent a violent concussion on stopping its momentum at the end of the descent; this causes a risk of accident from breakage of the chains, and the friction-break is also liable to derangement and expensive repairs.

At the Level Iron-Works, near Dudley, an instance occurred where a vertical lift had to be introduced in consequence of the furnaces being raised 16 feet in height. There were two furnaces—originally 34 feet high—raised to 50 feet high, and at the original height, the materials were wheeled on the level to the top of the furnaces. When the height of the furnaces was increased, the materials were required to be raised 16 feet, and a vertical lift was necessary in consequence of the situation being so much confined by a canal as to prevent the adoption of an inclined plane. For this purpose, the author of the present paper constructed a pneumatic lift, worked by the pressure of the air from the blowing-engine that supplied the blast for the furnaces. This lift was designed with the object of avoiding the objections to the plans of vertical lifting previously in use, and obtaining a safer and more economical application of power.

This pneumatic lift consisted of a heavy cast-iron cylinder, 4 feet 4 inches diameter inside, closed at the top, and inverted in a well filled with water, in which it was free to slide up and down like a gasometer; this cylinder was suspended from the top by a chain fastened to the circumference of a pulley, which was fixed on a horizontal shaft above the level of the top of the furnaces. A pipe from the air-main was carried down the well and turned up inside the cylinder, rising above the surface of the water, and when the blast was let into the cylinder through this pipe, the cylinder was raised in the water by the pressure of the compressed air against the top; this pressure was about 2 lbs. per square inch. A platform for raising the barrows of materials was suspended by a chain from another pulley on the same shaft as the former pulley, and the platform was guided in its ascent by vertical framing. The cylinder was heavy enough to draw up the platform with the load upon it, by descending into the water when the blast was withdrawn; and the empty platform was lowered by admitting the blast into the cylinder, and thus raising it. The cylinder was lowered again by opening a valve which let out the compressed air, and its velocity of descent was regulated by opening this valve more or less. The velocity of the platform, both in rising and falling, was completely under command, by regulating the opening of the valves for admitting or letting out the compressed air, and the velocity was gradually checked towards the end of each stroke with certainty and ease, so as always to stop the platform without concussion. The height to which the cylinder was raised was only 5 feet, and the two pulleys were made of different diameters so as to raise the platform 16 feet; the load raised upon the platform was about half a ton. This pneumatic lift has now been in constant work for 39 years, and has worked quite satisfactorily during the whole time; it has not required any repairs, except renewal of the chains, and repair of the rubbing parts. An accident happened once by the chain breaking whilst lifting, and the platform fell about 5 feet, causing a shock to the man going up with it, but no injury was done to the machinery.

An improvement on this pneumatic lift was made by the author of the present paper, in constructing a lift on a considerably larger scale at the Corbyn's Hall New Furnaces; constructed at the time of building the furnaces. The height to which the materials have to be raised is 44 feet 6 inches, and the present plan was designed to prevent the risk of an accident occurring through the breaking of a chain. There are four furnaces supplied by this lift, which is fixed between two of them, and the four furnaces are connected on the same level by the staging at the top, on which the barrows of materials are wheeled from the platform of the lift.

In this lift, the platform for raising the barrows of materials is fixed on the top of the air-cylinder, and it is raised by the pressure of the blast, the action being the reverse of the former plan. The air-cylinder is 5 feet 6 inches diameter, and 51 feet 6 inches long, constructed of riveted wrought-iron plates averaging $\frac{1}{4}$ inch thick, the plates being $\frac{5}{16}$ inch thick in the lower part, and $\frac{3}{16}$ in the upper part; the cylinder is closed at the top and open at the bottom, and has a throttle-valve 8 inches in diameter in the centre of the top, which is opened by pressing down the foot-lever fixed upon the platform.

The platform on which the materials are raised consists of planking carried on timber bearers, which rest upon the edge of the cylinder top, and upon four wrought-iron brackets carried out diagonally from the cylinder, to steady the platform, and fixed to two hoops passing round the cylinder.

Four timber guides are placed at the corners of the platform, and connected at top to the level stage upon which the barrows of materials are wheeled to the mouth of the furnace. These guides are faced with angle-iron on the inner edge, and a corresponding angle-iron is fixed in a notch at each corner of the platform, to slide easily up the guides; the height that the platform rises is 44 feet 6 inches.

Four cast-iron balance-weights are suspended outside the guides by chains which pass over the pulleys in the top-framing, and are attached to the four corners of the platform. These four balance-weights weigh about $6\frac{1}{2}$ tons, and the air-cylinder and platform together weigh 7 tons; leaving an unbalanced weight of about $\frac{1}{2}$ a ton to bring down the air-cylinder and empty the platform.

The air-cylinder descends into a well which is filled with water, and it is guided by four rollers, 6 inches long and 7 inches diameter, each of which works against a strip of bar-iron riveted on the cylinder, 4 inches wide, and the whole length of the cylinder. At the bottom of the well a foundation of timber is fixed, to form a stop for the cylinder in descending, and the cylinder rests upon the timber when at the lowest position, by a ring of angle-iron riveted round the bottom edge. The cylinder is stopped on rising to the top by a wood-block, fixed on each of the four guide-posts which stop the platform at the level of the top stage.

A cast-iron pipe, 7 inches inside diameter, conveys the compressed air from the air-main, and a pipe of the same size carries it into the cylinder, passing down to the bottom of the well between the cylinder and the side of the well, and rising up the centre of the cylinder; the end of the pipe is open, and stands above the level of the water.

A valve regulates the admission of the compressed air into the cylinder when the platform is raised, and also lets out the air from the cylinder when it is lowered. This valve consists of a plug or deep piston sliding in a vertical-bored cylinder of the same diameter as the air-pipe, which is closed at the top and open at the bottom. When the plug is in the lowest position, it closes the bottom of the cylinder, and the communication is opened between the two pipes, and the compressed air passes into the air-cylinder and raises it with the platform, by the pressure of the air upon the top of the cylinder and upon the surface of the water; the pressure of the compressed air is $2\frac{1}{3}$ lbs. per square inch, and the water is depressed inside the cylinder and raised on the outside, making a difference of level of 5 feet 4 inches. When the platform is required to be lowered, the plug-valve is drawn up to the top, closing the pipe that admitted the compressed air, and leaving the pipe open to the external air to discharge the compressed air from the cylinder; this discharge is accelerated by opening the escape-valve at the top of the air-cylinder by means of a foot lever.

The total pressure of the compressed air against the top of the air-cylinder is $3\frac{1}{2}$ tons; and deducting the unbalanced weight of the cylinder and platform $\frac{1}{2}$ ton, this gives an available lifting power of 3 tons. The load of materials raised varies according to the working of the furnaces, and the average load of materials raised each time is $1\frac{1}{2}$ tons, exclusive of the barrows and men, or about 2 tons gross weight. The lift is raised 16 times per hour during 20 hours in each day of 24 hours, or once in $3\frac{1}{3}$ minutes; and the total weight of materials raised each day is about 500 tons. The time of raising the platform from opening the inlet-valve to reaching the top is from 50 to 70 seconds, according to the load in regular work; and the time of lowering the platform is from 30 to 50 seconds, according to the degree of opening of the escape-valve on the top of the air-cylinder; the empty platform can be raised in 45 seconds and lowered in 25 seconds, with the present size of apertures.

In raising the platform, the inlet-valve is kept full open until it arrives at 14 inches' distance from the top, when it catches a lever which gradually draws up the plug of the inlet-valve, so far as nearly to close the pipe leading to the air-cylinder: this checks the moving power, and causes the velocity of the platform to be so much retarded by the time it arrives at the top, that the platform stops dead against the wood-blocks without any concussion being felt. The platform is held firmly up to these stops by the pressure of the air as long as may be required, without any recoil, and without requiring any catches to hold it, as it cannot descend in the least unless the air is allowed to escape from the cylinder, and the supply from the air-pipe keeps it full in case of any leakage taking place. When the platform is raised empty, a wood-block turning on a pivot is slipped by the foot under the lever that closes the inlet-valve, so as to begin closing the valve sooner: this is adjusted according to the velocity of the ascent of the platform, and regulates the lifting power so as to prevent any concussion on stopping at the top of the ascent.

When the platform arrives at the top, the men who go up with the barrows wheel them off to discharge the materials into the several furnaces; and as soon as the empty barrows are brought back, the platform is lowered by drawing up the plug of the inlet-valve to the top, which shuts off entirely the supply of compressed air, and opens the exit below the plug for the air in the cylinder to escape. This is done by the men on the platform at the top by means of a rod from the valve, carried up the framing; and the escape-valve on the top of the cylinder is then opened, and kept open till the platform is near the bottom, when it is closed, and the velocity of the platform is so much checked before stopping, that scarcely any concussion is felt at stopping: it can easily be stopped without any concussion.

The velocity of the platform is also gradually checked in descending, by the gradual immersion of the cylinder in the water, which reduces the unbalanced weight of the cylinder. The total loss of weight of the cylinder, when at its greatest immersion in the water, is $\frac{1}{2}$ a ton, which reduces the effective unbalanced weight of the cylinder and platform from $\frac{1}{2}$ a ton to nothing; but the weight of the four chains, amounting to $\frac{1}{8}$ of a ton is added to the balance-weights at the beginning of the descent, and is transferred to the platform at the end of the descent, and the result is, that the moving power causing the descent of the platform is reduced $\frac{1}{4}$ of a ton during the descent, being about $\frac{3}{8}$ of a ton at starting and $\frac{1}{8}$ of a ton at stopping: this moving power can be altered as required, by altering the balance-weights.

This lift was originally constructed to work only two furnaces, and the air-pipe was only 5 inches inside diameter, and the time of raising the platform was usually 140 seconds; when the other two furnaces were added, it became necessary to add a second air-pipe of the same size, for the purpose of working the lift twice as fast. When the lift was constructed, it was found that the well could not be made sufficiently water-tight, on account of a slight disturbance in the strata from the getting of the neighbouring mine, and an outer cylinder of similar construction to the air-cylinder was consequently sunk into the well; this outer cylinder having a close bottom, and holds the water in which the air-cylinder works, like the tank of a gasometer.

The quantity of air blown into the cylinder each time of raising it, is 1,128 cubic feet, and the total quantity per day of 24 hours is 360,960 cubic feet, or about 12 tons weight of air; the total quantity of air blown by the blast-engines is 16,185 cubic feet per minute, and 23,306,400 cubic feet, or about 780 tons weight of air per day of 24 hours. The proportion of the total blast that is used by the lift is therefore as 12 tons to 780 tons, or $\frac{1}{65}$ of the whole, and consequently $\frac{1}{65}$ part of the total power of the blowing-engines is employed in working the lift: there are two blowing-engines employed. The pressure of the blast is $2\frac{1}{3}$ lbs. per square inch, and the total engine power is consequently 165 horse power; and the air consumed by the lift being $\frac{1}{65}$ of the total blast, it follows that $\frac{1}{65}$ of 165, or $2\frac{1}{2}$ horse power, is the power that is actually employed in working the lift; this power being a constant one acting during the whole day, instead of acting merely at the times when the lift is rising. The actual power required to elevate the lift, with the average gross load of 2 tons on the platform, or $2\frac{1}{4}$ tons total weight, including the average unbalanced weight of the cylinder and platform, raised 44 feet 6 inches in 70 seconds, is 6 horse power; the greatest power employed being $3\frac{1}{2}$ tons raised that height in 70 seconds, which amounts to 9 horse power, and the least is $\frac{1}{4}$ of a ton raised in 45 seconds, amounting to 1 horse power. Thus it appears that the work of 6 horse power occurring at intervals, is performed by a power of $2\frac{1}{2}$ horses constantly acting.

The total consumption of coal-slack by the blowing-engines is about 13 tons per day of 24 hours, consequently the expense of working the lift is $\frac{1}{65}$ part of this, or 4 cwt. of coal-slack per day, costing about 5d.; and as this lift raises 500 tons of materials per day, it follows that 100 tons are raised 44 feet 6 inches high for 1d., or 4,450 tons are raised 1 foot high for 1d. The quantity of air required to fill the cylinder of the lift is 1,128 cubic feet, and the total content of the blowing-cylinder for one double stroke is 1,056 cubic feet; consequently, an increase in the rate of the engines of one stroke per minute is sufficient to raise the lift in 70 seconds, without diminishing the supply of air for the blast of the furnaces.

These two circumstances cause an important economy in working this pneumatic lift; a small power constantly acting is sufficient to do the work, and the sudden application of this power, concentrated into a short time, causes but a small increase in the rate of the engine. The total cost of this lift was about £500; and the cost of an inclined plane lift, including the engine for working it, would be about double that amount.

This pneumatic lift has been in constant work for the last nine years, and no accident or stoppage has occurred with it, except that the chain of one of the balance-weights broke once; the platform stopped with a very trifling fall, and was held in its position by the pressure of the air; no damage was caused, and the lift was got to work again within an hour's time. The only repairs that have been required since it commenced working, are the renewal of the chains of the balance-weights, and repair of the pulley-bearings; the set of chains can be taken off and replaced whilst the lift is standing during the dinner-hour, without causing any delay to the work. This is an important advantage, as it is essential to insure a continued supply of materials to the furnaces, and to avoid any risk of stoppage for repair of the lifting machinery.

The platform in this pneumatic lift cannot fall quicker than the time in which the whole body of air can escape, amounting to 1,128 cubic feet; and the greatest leakage that can arise from an injury of the cylinder, cannot let it down so rapidly as to cause any damage. The load is supported by an air-cushion during the whole time of its ascent, instead of depending on chains or racks, which prevents any risk of its falling. The complete control over the motion of the platform that is given by the air-valve which regulates the entrance and exit of the air, gives the means of checking, stopping, or reversing the motion at any part of the stroke; and it prevents any concussion at the ends of the stroke, although the lift has a quick action, and is stopped dead at each end of the stroke at the exact level required. The friction of the lift is very small, as the cylinder works through a water-joint; and in consequence of the low pressure at which it is worked, the loss at any leak is very small, and the strain upon the joints is much diminished.

This pneumatic lift is, of course, applied most economically and conveniently in the case of blast furnaces, where the compressed air can be obtained very economically, and without additional machinery; but it is probable that its application may be extended advantageously to several other cases, such as raising railway waggons, or even railway trains, discharging vessels at quays, and various other purposes, and it possesses several advantages which make it deserving of consideration. The low pressure at which it is worked, causes great simplicity and economy in the construction and working, the loss at leaks being reduced, and the joints easier kept in order; and the friction is very small, as the cylinder works through a water-joint. Where the lift is not required to be always working, but only to be worked at intervals, a further economy could probably be effected by employing a reservoir for the compressed air, to accumulate power during the time that the lift is not required to work, and thus reduce the size of engine requisite for the work; a large capacity of reservoir could be constructed at a moderate expense, on account of the low pressure upon it. It may be mentioned, that at the Corbyn's Hall New Furnaces, the reservoir of compressed air contains 5,000 cubic feet at the pressure of the blast, $2\frac{1}{3}$ lbs. per square inch, and consists of four wrought-iron cylinders from 6 to 8 feet diameter, constructed of riveted plates from $\frac{1}{8}$ to $\frac{3}{16}$ inch thick; and the cost would be about £3 per 100 cubic feet for air reservoirs of this construction.

In the discussion on this lift, the opinion of the meeting was expressed most favourably towards it, not only in its character as an elevator for furnaces, but also for raising and lowering trucks, and for loading and discharging vessels. Mr. Slate thought it was applicable for lifting and lowering railway waggons, and that a small blowing-engine might be advantageously employed for the purpose, working at a much quicker rate than usual, even at 700 feet per minute; the leakage of the piston would then be of less consequence. It was also suggested by Mr. Cowper, that steam might be used for the raising power when a blowing-engine was not at hand.

ON THE EXPANSIVE ACTION OF STEAM, AND A NEW CONSTRUCTION OF EXPANSION VALVES FOR CONDENSING STEAM-ENGINES.

By W. Fairbairn, Esq.

The innumerable attempts that have been made to improve the principle of the condensing steam-engine since the days of its celebrated inventor Watt, have nearly all proved failures, and have added little, if anything, to the claims, next to perfection, of that great man's ideas. It would be idle to speculate upon the various forms and constructions from that time to the present, which have been brought forward in aid of the original discovery of condensation in a separate vessel. All that has been done is neither more nor less than a confirmation of the sound views and enlarged conceptions of the talented author of a machine, which has effected more revolutions and greater changes in the social system, than probably all the victories and all the conquests that have been achieved since the first dawn of science upon civilized life.

It would be endless to trace the history of the successful and the unsuccessful attempts at improvement, which, for the last half century, have presented themselves for public approval; suffice it to observe, that no improvement has been made upon the simple principle of the steam-engine as left by Watt, and but few upon its mechanism. Among the latter may be enumerated the improvements in the construction and mode of working the valves; and of these, the D valve, by the late Mr. Murdoch, and the use of tappets as applied to the conical valves, appear the most prominent and the most deserving of attention.

In the construction of the parallel motion, the application of the crank, the governor, and the sun and planet motions, all of which have risen spontaneously from the mind of Watt, there is no improvement. The principles upon which all of them are founded have been repeatedly verified beyond the possibility of doubt, and their mechanism is at once so exceedingly simple, and so ingeniously contrived, as to limit every attempt at improvement in those parts of the steam-engine. What appears to be the most extraordinary part of Mr. Watt's engine is its perfect simplicity, and the little he has left to be accomplished by his successors.

It will be in the recollection of most persons conversant with the steam-engine, that the hand-gear for working the valves by the air-pump or plug-rod, gave a self-acting and continuous motion to the machine; and the facility which these means afforded for moving the engine in any direction, and at any required velocity, gave it a degree of docility and power beyond the expectations of its most sanguine admirers.

For a considerable length of time the hand-gear was the best and most effective mode of applying the motion of the steam-engine to the valves; subsequently, the oscillating and revolving tappets, fixed upon a shaft, and driven by wheels or by an eccentric, came into use, and, by means of vertical rods, communicated motion to the valves, and thus a similar effect was produced as by the hand-gear; next came Mr. Murdoch's D valve and eccentric motion, which, for simplicity, has never yet been equalled. The D valve, and the flat plate valve, are nearly synonymous, with this difference only, that the D valve presses with less force upon the face, and consequently works easier than the flat valve, which in every case is exposed to the full pressure of steam. It is true that means have been adopted to obviate this objection in large engines, by a preparation on the back of the valve, which is made steam-tight; and, by a communication with the condenser, a vacuum is formed over a proportionate area of surface, sufficient to equalize the pressure, and admit an easy motion of the valve.

The expansive principle upon which steam-engines are now worked, and the economy which this system has introduced in the expenditure of fuel, has effected considerable changes in the working of the valves, and has rendered the D and plate valves almost inadmissible for such a purpose. To the skill, ingenuity, and careful attention of the Cornish engineers, we are indebted for many of the improvements connected with the use and application of expansive steam; and taking into account the high price of coals, and the urgent necessity of economy in those districts, which, combined with a system of registry and encouragement held out by premiums, as described by Mr. John Taylor, we may reasonably conclude that other parts of the kingdom have been greatly benefited by the excellent examples set before them by the Cornish miners and engineers.

For a great number of years, and up to a recent period, the economy of steam and the working of the steam-engine expansively, were but imperfectly understood in the manufacturing districts; and although the Cornish miner set an excellent example, and exhibited a saving of more than one-half the fuel, there were, nevertheless, few, if any, attempts made to reduce what is now considered an extravagant expenditure in most, if not the whole, of our manufactories. But, in fact, the subject was never brought fairly home to the mill-owners and steam navigation companies, until an equalization or reduction of profits directed attention to the saving attainable by a different system of operation.

Ten years ago, the average or mean expenditure of coal, per indicated horse power, was computed at from 8 to 10 lbs. per horse power per hour; but now it is under 5 lbs. per horse power per hour in engines that are worked expansively; and even then they are far below the duty of a well-regulated Cornish engine, which averages from 2½ to 5 lbs. per horse power per hour.

This difference in the consumption of coal may be attributed to two causes: first, the conditions under which the duty of the two engines (that of the Cornish miner and the manufacturer) are respectively performed. The first being chiefly employed in pumping water, has the benefit of alternate action in overcoming the inertia of a large mass of matter, which, when once in motion, is easier continued, for a definite time, than a continuous power of resistance, such as exhibited in corn and cotton mills. Another cause is the greater care and attention which the Cornish man pays to his boilers, steam-pipes, &c.; they are never left exposed, but are carefully wrapt up in warm jackets, and well clothed, to prevent the escape of heat. Even at the present day, it is lamentable to see (in the coal and iron districts) the great and extravagant waste that is continually going on, for want of a little considerate attention in this respect. The only excuse is the cheapness of the fuel; but that is not an excuse, for if one-half can be saved, and coal could be got at 1s. per ton, it is certainly desirable to save sixpence out of the shilling, when that can be accomplished at a trifling expense. But one of the chief, if not one of the most important reasons for the exercise of economy in fuel, is the reduction of profits on articles manufactured by power: under these circumstances, a saving in coal becomes a consideration of some importance; and to these reductions alone may be traced the powerful stimulus which of late years has been prevalent in that direction. The low rate of profit in manufacturing operations, and a desire to economise and reduce the cost of production to a minimum, has been of great value in its tendency to improvement in the economy and efficient use of fuel; and also to the use of high-pressure steam, and its expansive action when applied to the steam-engine. In France, and most other parts of the continent, this system has been long in use; and although its effects, as well as its economy, have been long known in this country, it was only within the last few years that the benefits arising from it were appreciated. For a great number of years a strong prejudice existed against the use of high-pressure steam, and it required more than ordinary care in effecting the changes which have been introduced: it had to be done cautiously, almost insiduously, before it could be introduced. The author of this paper believes he was amongst the first in the manufacturing districts who pointed out the advantages of high-pressure steam, when worked expansively;* and for many years he had to contend with the fears and the prejudices of the manufacturers, before the present system of economical working was adopted.

The first attempt was by improvement in the construction of boilers † and subsequently in the valves of the steam-engine, adapted to either low or high-pressure steam, when worked expansively; the latter of which it is the principal object of the present paper to develop.

The expansive action of steam has been variously estimated by different writers, but all seem to agree in opinion that a considerable saving is effected by that process. It therefore becomes a question of importance in a community whose very existence almost depends upon the steam-engine, how to work it advantageously, and at the least possible cost. The great variety of schemes and forms which have been adopted for the attainment of these objects, have been exceedingly various, ingenious, and interesting; and the investigation of the different theories and applications that have been submitted for public approval, would form an exceedingly attractive, if not a useful, history of the various discoveries to which we are in a great measure indebted for the present improved construction of the steam-engine.

The elastic force and expansive action of steam were well known to Mr. Watt, and some of his immediate contemporaries and successors, such as Smeaton, Cartwright, Woolf, Trevithick, and others; but the fears of explosion at that early period, and the difficulty of constructing vessels strong enough to contain high-pressure steam, were probably the greatest drawbacks to its introduction. Woolf and Trevithick were probably among the first to grapple with this dangerous element; and the former, in order to economise fuel, introduced the double-cylinder engine, whereby a great saving was effected by increasing the pressure of steam in the boiler, and allowing it to pass from one cylinder to another of three or four times the capacity, by which its volume was expanded; and by these means a saving was effected, and an extra duty performed. If, for example, taking a double-cylinder engine, the high-pressure cylinder being one-fourth of the capacity of the cylinder from which the steam is condensed, there will be, for one cylinder full of steam, an expansion of four times its volume; this, of course, with a diminished pressure in the ratio of the capacities of the two cylinders. Comparing this with a similar process in a single cylinder equal in capacity to the two cylinders, and fitted with a well-constructed apparatus, regulated so that only one-fifth of the contents of the cylinder (equal in capacity to the small cylinder on Woolf's plan) is filled with steam of equal density, and the remaining four-fifths (equal in capacity to the larger cylinder) is allowed for expansion, it is evident that the communication being thus suddenly cut off from the boiler after the piston has been urged through only one-fifth of the length of the stroke, the expansive force is then used in completing the remaining four-fifths of the stroke, and the result must be nearly the same as that obtained with the two cylinders on Woolf's plan. The advocates of Woolf's system, however, insist upon its superiority, not from the actual force given out (which is rather in favour of the single cylinder than the double, in consequence of increased condensation in the steam passage between the two cylinders), but from the superior action and greater regularity of motion which in the former case is produced. To some extent this is the case, but not to any appreciable amount, provided the fly-wheel is well-proportioned to the pressure and power at which the engine is worked. In the double engines, which are now in common use, that is, when two single engines are coupled together with the cranks at right angles to one another, there is less occasion for a heavy fly-wheel, as the effect of a large expansion is less felt, if not effectually neutralized. The results, therefore, of the double-cylinder engine and the single engine, working at equal rates of expansion, are virtually the same as regards power and economy of fuel, if the comparison be not in favour of the single engine.

Having come to the conclusion, that the same duty can be performed by the single as by the compound engine, and considering the important advantage of simplicity in mechanical construction, in opposition to complexity, however ingeniously contrived, it becomes a question how to obtain an effective, as well as a simple process, for the attainment of that object.

The first attempt was by revolving tappets, which had been long in use; these being formed and regulated in such a manner as to cut off the steam at such a point of the stroke, as to give the exact quantity of expansion required. These tappets, to say the least, were from various reasons objectionable, as the weight of the vertical-rods and the slowness of their motion, prevented them from producing the desired effect. The steam valves could, however, be fixed so as to cut off the steam at the required point of the piston's passage in the cylinder, but the motion is not effected with the velocity essential to an efficient process of expansive action. Other processes have been tried for working steam-engines expansively, besides those already noticed; amongst them may be noticed the equilibrium valve, worked by double cams from the crank-shaft. This method is generally used and adapted to the marine and old engines, but its application is seldom of much value, unless the engines and boilers are capable of bearing a pressure of 15 lbs. to 20 lbs. on the square inch.

Another fault to which this description of valves is subject, is their distance from the steam-ports into the cylinder, and the large quantity of steam which occupies the space between the cut-off valve and the working cylinder of the engine. To remedy these defects, and to apply a better system of expansion to the common condensing-engines, the following apparatus and mode of working the valves was introduced:—

In giving a description of this effective and simple apparatus, it is but fair to state that the first idea of this invention was suggested by Robert Brownhill, at first imperfectly constructed, but since greatly modified and perfected by the author of the present paper.

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* See paper read before the Geological Society of Manchester, in the year 1840, on the Economy of Fuel.

† See Report on the Prevention of Smoke and Economy of Fuel.—*Transactions of the British Association*, 1844.

In the construction of a steam-engine, two important considerations present themselves,—the attainment of a maximum of force, and the minimum in the consumption of fuel; to acquire the first, it is requisite to form such an arrangement of the working parts, as to obtain the closest approximation to a perfect vacuum under and above the piston; and the other is accomplished by having as small an expenditure of steam as possible. These desiderata are to a great degree attained by the principle upon which these valves are constructed, and the way in which they are worked. In the drawings exhibited, each of the steam-chests contains two double-beat valves, also a shut-off valve and throttle valve: these valves constitute the whole of the openings by which the steam is admitted and returned from the cylinder; the valves next to the steam-pipe are those by which the steam is admitted to the cylinder, and the corresponding pair are the valves by which the steam escapes from the cylinder to the condenser. All the four valves are of the same area and dimensions; but the steam valves are not lifted up so high as the exhaust valves, for the reasons which are afterwards given. The double-beat valves of this construction have certain proportionate areas, the upper portion being larger than the bottom, in the ratio of 1.158 to 1.000. The object of this enlargement of the upper part of the valve being to give a preponderance to the pressure of the steam on the top side, in order to overcome the pressure of the packing in the stuffing-box which embraces the spindle, and to assist the gravitating force of the valve in its descent when liberated from the actuating cams.

The mode of working the valves is by the shafts and wheels deriving their motion from the crank-shaft. A vertical spindle, upon which two circular discs are fixed, passes through the steam-chests; and by its rotary motion, the cams, which are fixed upon the discs, raise the valves as they pass under rollers, which are connected to the valve-spindles by cross-heads, and by these means the valves are raised and retained open or shut for any definite period. The rollers are steadied by cross-heads sliding upon the vertical guide-rods at their outer ends, and sliding at their inner ends in vertical grooves in a centre boss, which is supported by guide-arms.

To work this engine economically, much depends upon the pressure of the steam and the amount of expansion given to the valves; the usual practice is to work with steam at 15 lbs. on the square inch, and cut off at one-half the stroke, and expand the other half; but in other cases, when the engines and boilers are calculated to bear a high pressure of steam, say from 30 to 40 lbs. on the inch, the cams are formed so as to cut off the steam at $\frac{1}{3}$ or $\frac{1}{4}$ of the stroke. There are generally three and sometimes four cams upon each of the discs, so as to cut off the steam at one-half, one-third, or one-fourth, or at any other point corresponding with the force of the steam and the load respectively.

To obtain this range of expansion, the rollers which work the steam valves are moveable, by brass strips which slide in the grooves in the cross-heads, so as to bring the roller over any one of the cams that may be required; and fixed pointers show, by a graduated scale on each brass slide, the exact point of the cylinder at which the steam is cut off; and by these means the extent of expansion is regulated and brought under the eye of the engineer.

It has already been stated, that the steam valves are not lifted so high as the exhaust valves; and the reason of this is, that as the exhaust valves are not variable in their action, and always require full openings into the condenser, it is desirable to retain them open throughout the whole length of the stroke. This process is effected with a greater degree of certainty than by any other description of valve. The exhaust valves are raised suddenly by the short inclined planes of the cams; and having allowed time for the escape of the steam from the cylinder, through a wide passage into the condenser, they suddenly fall by gravitation, and thus a more complete vacuum is formed under the piston than is probably attained by any other process.

The working of these valves is effected with a degree of certainty and simplicity which renders them very satisfactory, both as regards their efficiency in conducing to the economy of steam, and the perfect ease with which they are worked.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE—NINETEENTH MEETING.—BIRMINGHAM, SEPT. 12, 1849.

SECTION A.—MATHEMATICAL AND PHYSICAL SCIENCE.

President—Mr. W. Hopkins, F.R.S.
Vice-Presidents—Rev. E. H. Gifford, Sir W. S. Harris, Mr. J. C. Adams, The Dean of Ely.
Secretaries—Prof. Stevelly, Messrs. G. G. Stokes, W. R. Wills.

Committee—Lord Adare, Capt. Sir E. Belcher, Mr. C. Brooke, Sir D. Brewster, Mr. Birt, Rev. Prof. Chevalier, Dr. Evans, Mr. T. W. Gray, Prof. Hodgkinson, Mr. J. P. Joule, Rev. J. King, Dr. Lee, Rev. Dr. Robinson, Mr. F. Osler, Prof. Phillips, Rev. Prof. Powell, Mr. F. Ronalds, Col. Sabine, Col. Sykes, Prof. Wilson, Lord Wrottesley.

On taking the Chair, the President stated, in a few words, the main objects of the Association, and the general arrangement of the Sections.

Mr. Ronalds handed in his annual report "On the Kew Observatory," from which it appeared that the observations have, from the deficiency of applicable funds, been discontinued since the meeting in 1848; but a sum having been then voted for completing certain experiments in progress, and another sum for the reduction and discussion of the series of electric observations which commenced in August 1843, and terminated in 1848, the last year's work has been principally devoted to these objects; and it was deemed that good service has been rendered to the modes of magnetic investigation by this employment of the Observatory. The report proceeds to give an account, as usual, of the state of the establishment, including a complete inventory of the contents of the building. Then follows Mr. Birt's discussion of the electrical observations,—occupying a much too large part of the volume to be read, and therefore left for Mr. Birt to report afterwards in substance. A summary specification of the experiments of the year was given, viz.:—1. On the management of the light admitted into Mr. Ronalds's camera by suppressing his usual condensing lenses, and bringing the index of the magnet nearer to the lamp, by which means the time required for producing an efficient image on the paper was materially diminished. An improvement on Count Rumford's polyflame lamp was useful for heightening the brilliancy of the flame itself. 2. Experiments intended to determine the comparative advantages of a slit in a shield, and the index which had been hitherto used. The slit was found far preferable in the case of large and sudden excursions,—such as those occurring in Canada. 3. On the comparative advantages of Daguerreotype and Talbotype processes. The former was found for all these uses preferable, confirming Col. Sabine's anticipations. 4. Several experiments, more or less successful, on modes of copying the impression of the mercury on the plate,—in which assistance was derived from Mr. Malone. 5. Experiments of etching, either by the mezzotinto or dry-point method, on the daguerreotype plate itself, with a view to the circulation of the original observations, the plate remaining serviceable for a few more mercurial impressions. 6. Experiments suggested by Dr. Lloyd for procuring on the plate the same kind of zero line for measuring ordinates, as Mr. Ronalds had from the first procured upon paper, &c. 7. Experiments for the construction of an instrument for measuring ordinates of magnetic and other curves from the above-mentioned zero line, or in other instances. 8. Experiments for the improvement of daguerreotype apparatus for the process of cleaning, polishing, and coating plates used for the purposes of these observations, with some other experiments of less consequence. The volume, further, contains the full details, illustrated with five plates, of the apparatus, resulting in part from the foregoing series of experiments, and sent by Col. Sabine to the Toronto Observatory for immediate use. An advantage of this arrangement is, that no *hygrometric* expansion or contraction can have sensible effect on the required results. Mr. Ronalds's correspondence on the subjects of electricity and magnetism seems to have had beneficial results. In the last place is presented, as usual, a list of proposals for new experiments at Kew, extending to twelve heads,—one of the most urgent of which Mr. Ronalds considers to be the prosecution of experiments commenced at the Observatory in 1845, and suspended for want of funds, on the important subject of *frequency of atmospheric electricity, a subject unaccountably neglected since the observations of Beccaria, at Turin, in the middle of the last century*, and one which seems to Mr. Ronalds to grow in importance with the growth of our chemical and magnetical information. Others of these proposals embrace a course of inquiry in magnetism, electricity, and various meteorological phenomena, all requiring only a sufficient Observatory-Staff to be beneficially carried out.

SECTION B.—CHEMISTRY, INCLUDING ITS APPLICATIONS TO AGRICULTURE AND THE ARTS.

President—Dr. Percy, F.R.S.
Vice-Presidents—Prof. Apjohn, Prof. Graham, Mr. R. Phillips, Dr. Miller, Dr. Andrews, Mr. J. Gassiot.
Secretaries—Messrs. G. Shaw and R. Hunt.

Committee—Dr. Faraday, the Marquis of Northampton, Dr. Schrœter (Vienna), Prof. Magnus, Prof. Daubeny, Dr. L. Playfair, Messrs. W. West, T. Pearsall, Prof. Forchammer, Dr. De Vry, Dr. Schunck, Messrs. W. H. Pattison, R. Warrington, T. Ward, G. Teschmacher, Prof. Ronalds, Messrs. J. P. Joule, R. Mallet, Dr. Scoffern, Capt. T. L. Lewis, Dr. Gladstone, Prof. Wilson, Prof. Rinman.

"On the combined use of the Basic Acetates of Lead and Sulphurous Acid, in the Colonial Manufacture and the Refining of Sugar, by Dr. Scoffern."—Dr. Scoffern, after a few preliminary remarks on the anomalies which beset the colonial sugar-manufacturing functions, stated the actual amount of pure white and crystallizable sugar existing in the sugar-cane juice to be from 17 to 23 per cent., and the amount of juice contained in the cane to be about 90 per cent.; of this amount only 60 per cent. on an average is extracted,—and of this quantity only one-third part of its sugar is obtained, in a dark impure condition, instead of white and pure as it might be extracted. The operation at present generally followed in the colonial production of sugar involved the use of lime, an agent which, although beneficial in separating certain impurities and decomposing others, effects both these agencies at the expense of two-thirds of the original sugar. Curious plans had been followed to avoid the use of lime,—alumina, in its hydrated condition, had been employed, but with inconsiderable success. As a purifying agent the basic acetate of lead was known to be most potent, but could not be generally employed, owing to the existence of no sufficient means of separating any excess of that agent which might remain. Dr. Scoffern effects this separation by means of sulphurous acid forced by mechanical means into the sugar solutions. The process had been used for more than twelve months in one of the large British refineries, and a lump of sugar prepared by means of the operation was exhibited. The advantages presented by this operation were thus summed up:—1. As applied to cane-juice, and other natural juices containing sugar, it enables the whole of the latter to be extracted instead of one-third, as is now the case; and in the condition of perfect whiteness, if desired, without the employment of animal charcoal. Owing to the complete separation of impurities, the juice throws up no scum when boiled, and therefore involves no labour of skimming. Finally, the process of curing is effected in less than one-third of the present time,—and the quality of the sugar being in all cases so pure and dry, no loss in weight occurs during the voyage home. 2. As applied to the refinery operation, it enables the manufacturer to work upon staples of such impurity that he could not use them on the old process. It yields from these staples a produce equal in quality to the best refined sugars produced heretofore—in larger quantity, and in less time. It banishes the operation of scum-pressing, the employment of blood and lime. Finally, its cost is even less than that of the present refinery process.

Dr. Miller remarked, that it had been objected that sulphurous acid absorbed oxygen, and passing into sulphuric acid impaired the grain of the sugar. Dr. Playfair said it had been stated that sulphurous acid gave a taste to the sugar. Dr. Scoffern observed that his specimens proved that neither of these objections was valid. It having been asked if voltaic electricity had been found successful in removing the salts of lead from the sugar in Dr. Scoffern's process; Dr. Faraday expressed his opinion that it was impracticable. Prof. De Vry thought the molasses would contain acetate of lime which would be unfit for the uses to which it is put in Holland.

"On the presence of Fluorine in the waters of the Firth of Forth, the Firth of Clyde, and the German Ocean," by G. Wilson, M.D.—In 1846, the author announced the discovery to the Royal Society of Edinburgh, of fluorine as a new element of sea-water. He was led to search for it, after observing that fluoride of calcium possesses a certain small but marked solubility in water, which explains its occurrence in springs and rivers, and necessitates its occasional, if not constant presence in the sea. The only specimens of sea-water he had examined before this summer, were taken from the Firth of Forth, at Joppa, about three miles from Edinburgh. He obtained the mother-liquor or bittern from the pans of a salt-work there, and precipitated it by nitrate of baryta. The precipitate, after being washed and dried, was warmed with oil of vitriol in a lead basin, covered with waxed glass having designs on it. The latter were etched in two hours, as deeply as they could have been by fluor-spar treated in the same way, the lines being filled up with the white silica, separated from the glass. The author has recently examined in the same way bittern from the salt-works at Saltcoats, in the Firth of Clyde, but the indications of fluorine were much less distinct than in the waters on the east coast. On procuring, however, from the same place, the hard crust which collects at the bottom and sides of the boilers used in the evaporation of sea-water, he found no difficulty in detecting fluorine in the deposit. This crust or deposit consists in greater part of sulphate of lime, and of carbonate of lime and of magnesia, but it contains also much chloride of sodium, and the other soluble salts of sea-water, entangled in its substance. When sulphuric acid, accordingly, is poured on it, it gives off much hydrochloric and carbonic, as well as some hydrofluoric acid, and the latter is thus swept away before it has time to corrode the glass deeply. The author preferred, nevertheless, to use the crust exactly as he got it, that the proof of the presence of fluorine might not be impaired in validity by the possibility of that substance being introduced by the water or re-agents which must have been employed, had the chlorides and carbonates been separated from the crust by a preliminary process. The crust, accordingly, after being dried and powdered, was placed along with oil of vitriol in a lead basin covered by a waxed square of plate glass, with letters traced through the wax. A single charge of the crust and acid corroded the glass very slightly, but by replenishing the basin with successive quantities of these materials, whilst the same plate of engraved glass was used as the cover, he found no difficulty in etching the glass deeply. Operating in this way, he has found fluorine readily in the boiler deposit from the waters of the Firths of Forth and Clyde. It is a less easy matter to subject the waters of the open sea to the requisite concentration, before examination. It occurred to the author, however, that the incrustations which are periodically removed from the boilers of the ocean steamers would serve to determine the question, whether fluorine is a general constituent of the sea. He made application, accordingly, at Glasgow and Leith for the deposits in question. It appears, however, that the deep-sea steamers which leave the former have their boilers cleaned out at other ports, so that he has as yet been unsuccessful in procuring crusts from the west coast of Scotland. He has obtained at Leith the crust from the boiler of a steamer called the Isabella Napier, which trades between that port and Wick, so that the greater part of the water consumed as steam by its engines is derived from the German Ocean, although a portion is necessarily obtained from the Firth of Forth. The crust from the boilers of this vessel was treated in the way described, and at once yielded hydrofluoric acid. A single charge, indeed, of the materials marked the glass distinctly, and four charges deeply. We may therefore infer that fluorine is present in the waters of the German Ocean, for different portions of the deposit yielded it readily, and marked glass as deeply as the deposit from the water of the Firth of Forth did, which could not have been the case if the whole crust had not contained fluorine pretty equally diffused through it. From what is known of the comparative uniformity in composition of sea-water, it may safely be inferred that, if fluorine be present in the waters of the Firths of Forth and Clyde, and in the German Ocean, it will be found universally present in the sea. Mr. Middleton, before 1846, came to the conclusion that fluorine must be present in sea-water, since it occurred, as he had ascertained, in the shells of marine mollusca. Silliman, junior, without a knowledge of Middleton's views, drew the same inference from its invariable presence in the calcareous corals brought to America by the United States expedition from the Antarctic Seas. The author has found fluorine abundantly present in the teeth of the walrus, which points to its existence in the Arctic Ocean; and it seems so invariably to associate itself with phosphate of lime, that it may be expected to occur in the bones of all animals, marine and terrestrial. The author has found fluorine likewise in kelp from the Shetlands, but much less distinctly than he anticipated. Glass plates were only corroded so far as to show marks when breathed upon. Prof. Voelker, also, was kind enough, at the author's request, to search for fluorine when analysing the ashes of specimens of the sea-pink (*Statice Armeria*), which had grown close to the sea-shore, and contained iodine, and found fluorine in the plant. When all those facts are considered, it is not too much, the author thinks, to urge that fluorine should now take its place among the acknowledged constituents of sea-water. He has entered at length into the consideration of the natural distribution of this element, and into other details connected with it, in a paper in the 'Transactions of the Royal Society of Edinburgh,' vol. xvi. part 7, and in a communication made to the Association at its Southampton meeting. The *Statice Armeria* may certainly be added to the list of plants containing fluorine, and so may the *Cochlearia Anglica*, in specimens of which, obtained from the Bass Rock, and analysed in Dr. Wilson's laboratory, Dr. Voelker has also detected this element.

Specimens of etched glass were shown to the Section in illustration of this communication.

Professor Forchammer confirmed the results of Dr. Wilson. He had examined sea-water from near Copenhagen, and found fluorine in every instance. He had also examined many shells and marine products from various localities, and they all gave the same body—the quantity of which was always greater in sea than in land animals. Mr. Pearsall thought he had detected fluorine in many waters from springs and rivers.

"On Phosphorus as producing cold short iron," by Mr Rinman.—This was a statement of the discovery in the Swedish iron of phosphorus, whenever it presented the peculiarity of being cold short, as it is technically termed. The process adopted was the following:—The pig-iron, weighing about three grammes and reduced to small pieces, was dissolved in diluted nitric acid, the solution evaporated to dryness, the dry mass heated strongly with free access of air in order to destroy all carbon. After heating, the dry mass was triturated and mingled with six times its weight of soda, a little chlorate of potass, and a little silica, and smelted as long as any gas was disengaged. The smelted mass was exhausted by boiling water, and digested for some hours. The solution was filtered, the undissolved residue washed with hot water, containing a small quantity of chloride of ammonium. The solution was evaporated to dryness, and the dry mass treated with hydrochloric acid, and dissolved in water. After filtration, the solution was neutralized, and the phosphate of lime was precipitated in a closed vessel by a solution of chloride of calcium with ammonia. This method is published more extensively by T. Akerman, professor in Fahlun.

Dr. Percy spoke of the importance of this inquiry, particularly in such a district as Birmingham. He then instanced many of the peculiarities of the Staffordshire iron which contain phosphorus; and spoke of the peculiarity of the Berlin iron, which is so singularly fluid in casting, as being probably due to some such combination.

"On the comparative cost of making various Voltaic Arrangements," by Mr. W. S. Ward.—The author stated that a series of calculations, founded on data produced to the Chemical Section at Swansea, showed the efficient power of three generally-used forms of battery, known as Smee's, Daniell's, and Grove's, would be equal when 100 pairs of Smee's, 55 pairs of Daniell's, or 34 pairs of Grove's were used, and that the expense of working such batteries, as regards a standard of 60 grains of zinc in each cell per hour, would be about 6d., 7½d., and 8d. respectively.

The communication led to conversations on the economy of the Electric Light and Electro-Magnetic Engines, in which Dr. Faraday, Mr. Shaw, Mr. Hunt, Mr. Elkington, and other gentlemen joined.

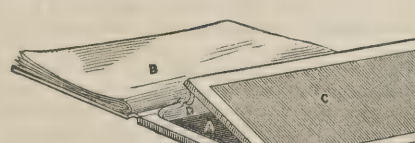
Dr. Faraday remarked on the imperfect character of the electric light, and its inapplicability for purposes of general illumination—all objects appearing dark when the eye was embarrassed by the intensity of the electric arc.

Mr. Shaw and Dr. Percy instanced the magneto-electric machines which are employed at Birmingham for electro-plating, in which the current cost of the motive power, viz., a steam-engine to put the magneto-electric machine in action, was the only working cost.

Mr. Elkington stated that they had never been induced to abandon the voltaic battery which they employed in their manufactory, finding it more economical than the magneto-electrical machine of which he was the patentee. He also stated the remarkable fact, that a few drops of the sulphuret of carbon added to the cyanide of silver in the decomposing cell, had the property of precipitating the silver perfectly bright, instead of being granulated, or so dead as it is when thrown down from the solutions ordinarily employed.

MONTHLY NOTES.

Jennens & Bettridge's Writing Folio Desk.—Messrs. Jennens and Bettridge, the eminent papier-maché manufacturers of Birmingham, have recently registered a useful combination of a writing-desk and portfolio, which seems to afford very great conveniences to the writer. Our sketch shows the desk open for writing upon; the outside covers, A and B, lie flat on the table, and to the front one is hinged a moveable flap or desk-piece, C. To the opposite edge of this desk is hinged a moveable support, D, which, when in use, is set on edge in a cavity or recess in the upper side of the cover, A, and carries the desk at the required angle for writing. When closed, the apparatus takes the form of a plain portfolio, the support, D, folding down by its hinges upon the bottom of the recess in the cover. This recess also answers as a pocket or receptacle for letters and loose sheets, whilst it takes up no more space than a simple portfolio. The contrivance offers all the advantages of a complete desk, and repository for the several accompaniments required in writing and drawing.



Copper Printing Types.—It has been proposed to form types for printing by a new mode, which involves the use of solid unfused metal. The plan, which was brought forward at one of the soirees of Lord Rosse, as President of the Royal Society, is the invention of M. Petit, who exhibited the machine in which his letters are formed. The metal used, is copper in long strips of a rectangular section, wound round a cylinder when ready for conversion. These strips are passed gradually from the cylinder to an arrangement of steel dies and matrices worked by great pressure, so as to produce the letters on the solid copper. Whether, in the event of this system of letter-making answering on a large scale, the copper will be found as effective a printing surface as the usual type metal, is in some degree open to doubt; of its durability there can be none, as its hardness compared to type metal is as 100 to 1. The metal is, in addition, much increased in density by the pressure it receives in the machine. The speed of production is at the rate of 32 letters per minute—the characters being sharp and well formed. A well-known example of the durability of copper in printing, is shown by the fact, that a London house, in the habit of printing stamps for government, use raised copper surfaces for the purpose, from each of which they can take 125,000,000 of impressions.

Agricultural Science.—By a late impression of the *Carlisle Patriot*, we see that a knot of English farmers in Cumberland, have come forward to challenge the presumed superiority of the "scientific treatment of the soil" of the well-known Mr. Mechi of Tiptree Hall, in comparison with their own old-fashioned system. Mr. W. Hodgson, a tenant farmer of the Earl of Lonsdale, at Low Walton, near Whitehaven, has undertaken the office of challenger, which is "for any sum, from twenty to one hundred pounds, to produce a crop of Swede turnips, equal to a crop at present upon my farm, soil and situation considered." In the event of this appeal being answered, the like sum is wagered as to who can show the best-managed farm, with reference also to the general quality of stock thereon. From Mr. Mechi's eminence as an agriculturist, something interesting may be looked for from this trial of skill with a northern farmer of Mr. Hodgson's attainments.

Locomotive Engine-Drivers.—We are sorry to find that considerable dissatisfaction prevails amongst the engine-drivers on the Eastern Counties line—foretelling, as matters now stand, a repetition of the late disturbances amongst the same class of men on the London and North-Western. The present cause of complaint is, that a system is now in operation, whereby the experienced drivers are discharged from the company's service, so soon as, in the regular scale of promotion, they arrive at the receipt of 7s. 6d. a day, when young firemen at 4s. 6d. or 5s. 6d. a day are substituted. If this is the rule, the men have indeed good reason to grumble, for such an arrangement will speedily carry off the whole of the present race. On the York, Newcastle, Berwick, and other lines, it is also said, a movement is going on for an increase of the present wages of 6s. 6d. to 7s. 6d. a day. About 350 men have given notice to leave their employment, unless this demand is complied with.

Improvement in Engravings.—Mr. Leith the lithographer, of Edinburgh, has recently invented a plan whereby he can give to ordinary prints all the beauty of India proofs. We are not at present in possession of the particulars of his process, but we understand that several leading metropolitan printsellers have submitted engravings to him for a trial of it. If the contrivance is a cheap one, we may look forward to an inundation of India proofs.

Shanks' Method of Casting Pipes.—A curious mode of casting pipes and other hollow regular figures, has been patented by Mr. Andrew Shanks of London. It consists in the substitution of centrifugal force in place of a core, in forming the hollow of the pipe. An iron mould, of a bore equal to the external diameter of the intended pipe, is prepared, and arranged to revolve horizontally. When a pipe is to be cast, a sufficient quantity of metal is poured into this mould, which is then set in rapid motion, and the centrifugal force throws the cooling metal outwards, so as to form an internal coating upon the mould; and the motion being continued, the metal sets, producing a pipe, the hollow in which is formed simply by the action described, and without using any core. In the earlier stages of the experiments, we believe, very fair pipes were produced in this way, so long as short lengths only were attempted; but latterly, at Johnstone, where the trials are being made by the patentee's brother, unforeseen difficulties have occurred. The chief of these is, that on a large scale, the centrifugal power appears to fail in giving a regularity of bore. The metal seems to stick at different places, and the result is an an uneven bore, inferior to that of a pipe moulded in the usual way.

Discovery in Ventilation.—At a time when cholera, with an appalling voice, calls the most earnest attention to house ventilation, and dreadful explosions and loss of life in mines demand no less anxious efforts to devise means for the prevention of these calamities, we have much satisfaction in anticipating that human residences may easily be supplied with a continual circulation of wholesome air, and the most dangerous subterraneous works be preserved against accidents from foul currents or fire-damps. Dr. Chowne has enrolled a patent for improvements in ventilating rooms and apartments, of the perfect efficacy of which, we believe, there cannot be a doubt, and on a principle at once most simple and unexpected. Without going into details at present, we may state that the improvements are based upon an action in the syphon which had not previously attracted the notice of any experimenter—namely, that if fixed with legs of unequal length, the air rushes into the shorter leg, and circulates up, and discharges itself from the longer leg. It is easy to see how readily this can be applied to any chamber, in order to purify its atmosphere. Let the orifice of the shorter leg be disposed where it can receive the current, and lead it into the chimney (in mines, into the shaft), so as to convert that chimney or shaft into the longer leg, and you have at once the circulation complete. A similar air syphon can be employed in ships, and the lowest holds, where disease is generated in the close berths of the crowded seamen, be rendered as fresh as the upper decks. The curiosity of this discovery is, that air in a syphon reverses the action of water, or other liquid, which enters and descends, or moves down in the longer leg, and rises up in the shorter leg. This is now a demonstrable fact; but how is the principle to be accounted for? It puzzles our philosophy. That air in the bent tube is not to the surrounding atmosphere as water or any heavier body, is evident; and it must be from this relation that the updraft in the longer leg is caused, and the constant circulation and withdrawal of polluted gases carried on. But be this as it may, one thing is certain—that a more useful and important discovery has never been made for the comfort and health of civilized man. We see no end to its application. There is no sanatory measure suggested to which it may not form a most beneficial adjunct. There is not a hovel, a cellar, a crypt, or a black close hole anywhere, that it may not cleanse and disinfect. We trust that no time will be lost in bringing it to the public test on a large scale, and we foresee no impediment to its being immediately and universally adopted for the public weal. We ought to remark, that fires or heating apparatus are not at all necessary; and that, as the specification expresses it, "this action is not prevonted by making the shorter leg hot whilst the longer leg remains cold, and no artificial heat is necessary to the longer leg of the air-syphon to cause this action to take place." Extraordinary as this may appear, we have witnessed the experiments made in various ways, with tubes from less than an inch to nearly a foot in diameter, and we can vouch for the fact being perfectly demonstrated. Light gas does descend the shorter leg when heated, and ascends the longer leg where the column of air is much colder and heavier.—*Literary Gazette.*

Practical Blunders.—The newspapers have lately talked pretty freely of some new gravitation machines for the *manufacture* of motive power. One story gives credit to a Mr. Jackson, a mechanician of Northampton, for the invention of a hydraulic gravitation engine; and another mentions a Mr. Thomson, as having achieved the production of power by the use of dead weights, actuated by a *very small* steam-engine. A large wheel is stated to be employed with sliding weights and leverage, so arranged as to produce of themselves a power of progression, only requiring the aid of a very small engine to overcome the dead points, where the weights have to be raised in their most disadvantageous position, whilst generating an auxiliary power in re-descending. Not many days ago, we ourselves were shown a model of a machine embracing the latter principle, if principle it can be called. It is the invention of a mechanic in our immediate neighbourhood, who, after numberless sleepless nights, has, at last, arrived at his long-desired object. The arrangement is simply that of a lever with the wonderful weights, which, by a slight manual action, are proposed and intended to produce sufficient tractive-power to draw a loaded train of carriages. It is painful to be compelled to give a plain opinion on the merits of such visionary schemes, which would have vanished under a week's application to the rudimentary principles of mechanics.

The High Level Railway Bridge at Newcastle.—This extraordinary bridge, the design of George Stephenson, was partially opened for traffic a few weeks ago. Its peculiar characteristic is, that from the immense arches carrying the railroad, is suspended a carriage and footway, so that, whilst the upper surface is occupied by a train of carriages, the lower platform forms a safe passage for carts and pedestrians. The bridge is 112 feet 6 inches from the parapet to the high water line, and the suspended roadway is 80 feet above the water. The cast-iron arches, six in number, are of 125 feet span. The piers are of masonry, and the arches, pillars, and transverse girders and braces, are iron. The roadway is 20 feet 4 inches wide, and 10 feet high; and footways, 6 feet 3 inches wide, are carried, one on each side, between the two lines of the great ribs of the arches.

Fitzmaurice's *alias* Galloway's Rotatory Engine.—Amongst the last novelties of the daily press, is an account of a wonderful rotatory engine, said to be invented by a Captain Fitzmaurice, who has carried on a series of practical experiments with it, in a 10-ton pinnace, on the Thames. Since the publication of these particulars, Mr. Elijah Galloway has issued his claim as the true inventor; and in a letter addressed to the daily papers, he adds that, by not standing by his rights at an early stage in the case of "Morgan's paddle-wheel," he all but lost the credit of this also, which all interested in such matters know to be his sole invention. Captain Fitzmaurice appears to be the assignee of the invention, and Mr. Galloway admits that some credit may be due to him for perfecting details, but his right to be considered the inventor is utterly groundless. Whilst we are on the subject, we may add some of the particulars of the production, which lately appeared in the *Times*. The engine is very simple, merely consisting of two pieces so mathematically arranged, that the interior part works in the outer with the greatest ease, being free from dead points, and without the slightest vibration, however great the velocity. It has no springs or packing, and the parts meet each other so harmoniously as only to give a humming noise like a spinning-top, and is not in the least liable to get out of order, the wear being perfectly uniform throughout. The entire motion being a rolling instead of a cutting one, the engine will last long without repair, as the surfaces become case-hardened in a very short space of time. The trials took place in the presence of several scientific gentlemen, and engineers of eminence in their profession, in a frigate's pinnace, the engine being constructed for the Government. The boat is of 10 tons burden, carrying a load of $5\frac{1}{2}$ tons, and drawing 4 feet of water. She is 32 feet long, and 8 feet breadth of beam, made for carrying men and carronades, but not in any way calculated for speed; and yet the engine of 10 horse power, occupying a space of 21 inches by 7 inches, drove a screw-propeller, of 3 feet in diameter and 4 feet pitch, with such velocity as to make 200 revolutions in a minute, the motion being given on the direct-action principle. Although the boat was not at all calculated for speed, she was propelled against the stream a distance of two miles in twenty minutes, equal, allowing for the strength of the current, to eight miles an hour. The engine weighs considerably less than 1 cwt. to each horse power, and requires much less fuel than the ordinary engines: it is so easily set in motion, graduated to any velocity, or stopped, that a boy of twelve years of age might manage it with one hand. It was made under the superintendence of Mr.

Bulman, jun. of Croydon, who has given great satisfaction to his employers; and the best judges have pronounced a high opinion of its capabilities, after witnessing its performances. Captain Fitzmaurice makes no secret of the invention, but shows its interior freely, as it is intended for the public service. An engine of 100 horse power on Captain Fitzmaurice's construction, would only occupy a space of 4 feet by 2 feet.

Birmingham in its Sanatory Condition.—Strange to say, up to the week in which we write, only one indigenous case of cholera has occurred within the walls of Birmingham. True, two other deaths from this fearful malady have taken place, but these have been incontestably proved to be imported cases. Those who know the town, and have seen its wide streets, its general cleanliness, and its ambition in the way of small gardens, will not be at a loss to account, at least in a great measure, for its hitherto peculiar salubrity. Amongst other places, Glasgow may indeed take an example from it, in the promotion of cleanliness, and in attempting to put down the evil system of close and high-piled building, where the labouring man, when resting from his toils, is prevented from viewing aught but masses of crowded erections like his own, and the small garden of the Birmingham artisan is nowhere to be found.

Davies' Rotatory Engine.—Amongst the attractive curiosities in the mechanical division of the Birmingham exposition, is a sectional model of this engine, equal in size to 100 horse power. A beautifully-constructed model, in complete working order, is also exhibited, together with an illustrative set of cams, as employed in working the valves and diaphragms of the engine. During the meeting of the British Association, several illustrious visitors examined the models with great interest, and afterwards inspected the 12-horse working engine at Messrs. Edelsten & Williams' pin-works in George Street. When we saw this engine last week, we found it working as smoothly as at our former visit to it, nine months ago. It is apparently doing its duty well, and throughout its two years' trial it has kept up a steady uniform speed of seventy revolutions per minute, without causing a single stoppage to the works.

British Association.—It is pleasant to remark upon the universal good feeling which appears to meet the British Association from every quarter. Amongst the very numerous invitations which have recently been showered upon it, Manchester, Bath, Ipswich, and Hull, with several others, have put in their claim to the right of hospitably entertaining the members, and at the same time bringing their own peculiar characteristics more prominently forward. From Hull, invitations were forwarded from the Mayor and Town-Council, the Athenæum, Mechanics' Institution, Literary and Philosophical Society, the Corporation of the Trinity House, the Dock Company, the Kingston Cotton Mills, the Hull and Selby Railway Company, and the Hull Flax and Cotton Mills. Letters of invitation were also received from the Magistrates, as also from Sir T. A. Clifford Constable, Bart., R. Bethell, Esq., M.P., and H. Broadley, Esq., M.P.; Lord Hotham and the Earl of Yarborough are also understood to have added their influence. In support of the claims of Ipswich, Messrs. Ransome & May handsomely offered the Association the use of some half-dozen of the immense rooms of their workshops, which they would clear out for the purpose, and fit up in a suitable manner. All bids fair for another successful reunion at Edinburgh, under the presidential auspices of Sir D. Brewster.

Wandering Paragraphs.—Self-Heating Shot for War Purposes.—The wanderings of "stolen or strayed" paragraphs are often peculiarly interesting. We have just now been watching the course of one of our own, which left home under pressing circumstances. It originally appeared as far back as our June number, under the name which stands at the head of these notes. Next we saw it, denuded of any acknowledging mark, in the columns of a Glasgow newspaper; hence it passed through those of the innumerable metropolitan and provincial press, until the great "thunderer" itself took charge of it. For the present it has disappeared, probably to come forward again at some favourable opportunity.

Fire-Damp in Coal Mines.—At a late meeting of the Society of Arts, a paper was read from Mr. Edginton on ventilation and fire-damp in coal mines. After describing the nature and causes of fire-damp, and its explosive properties, when brought in contact with the atmosphere, Mr. Edginton proceeded to say, that when the roof fell in in a coal mine, a large disengagement of the gases was thereby occasioned, and that there the Davy lamp, which had been so greatly praised and extensively used, was of very questionable use; that although the accidents which occurred where the Davy lamp was used were ascribed to the carelessness of the men, such was not the case; those accidents were rather to be attributed to the defects of the Davy lamp, which had, in his opinion, been unworthily called a "safety lamp." He stated that ventilation was the most rational way to prevent explosions of fire-damp. He then pointed out the best methods of ventilation, and illustrated his plan by a display of diagrams. The "Clanny," or the safety lamp invented by Dr. Clanny, differs but little in form from the "Davy;" yet it is a curious fact, that the inconveniences attending the latter are, happily, obviated in the "Clanny" lamp. And although the number of meshes in this, amount to the astonishing number of 1,296 to the square inch, through which air for combustion passes, yet, such is the fineness of its texture, that the light is no ways obscured by it. It should also be observed, that the air passes *downwards* (the reverse of the other), in safety through the meshes, and immediately afterwards within the whole depth of a very thick and well-annealed glass cylinder; by this discovery in the "Clanny" lamp, the atmospheric air, when mixed with fire-damp at the exploding point, is rendered completely innoxious, being greatly expanded in volume, and passes off in safety. Whilst it gives a much more preferable light, it burns much longer than the other; besides, when the flame is extinguished, the blue flame of fire-damp, in the whole cylinder, instantly disappears in the most quiescent manner; at the same time readily indicating to the miner the nature and extent of fire-damp contained at the moment in the atmosphere of the mine From the flame of the lamp being surrounded by the glass cylinder, no blower, or unmixed fire-damp, or yet of strong currents of fire-damp, however explosive and dangerous they may be, can come in direct contact with the flame of the lamp; nor can the pitman unscrew it, to draw the flame for the purpose of lighting his pipe; this alone would give it a preference over all other lamps used for the purpose. Its light is sufficient for the pitman's purpose in hewing, as well as for separating the argillaceous schistus, &c. &c. from the good coal. There have been persons, whose shallow experience in mining have found fault with the glass cylinder, but without a shadow of truth; for the scientific viewer looks at it, next to the wire-gauze, as the *ne plus ultra* of the discovery; and it is a well-known fact, that this lamp has been in daily use for a number of years in many of the most dangerous coal mines, without a single accident.

Boutigny's Experiments with Melted Metal.—From the beautiful experiments made some time back, on the spheroidal condition of water and its reference to certain cases of steam-boiler explosions, M. Boutigny has turned his attention to a class of researches on heat in a different and certainly a very novel direction. He states that, by investigation, he has proved that melted metals possess, in a remarkable manner, repulsive force of incandescent surfaces, showing that the tricks of fire-eaters and conjurors are connected with a high class of physical facts. He has divided, or cut through with his hand, a jet of molten metal, of five centimetres in diameter, on escaping from a tap; the other hand he plunged into a vessel full of incandescent metal. Whilst trembling at the appearance of the ordeal, both hands came out unhurt. It appears that no particular precautions are necessary to prevent the disorganizating action of the heated fluid. The experimenter must betray no fear, but pass his hand rapidly, and yet not too rapidly, through the metal. When the skin is moist, success is certain; and in facing masses of fire, the dread ordinarily supplies the necessary moisture—so that with a very slight degree of attention he may be rendered invulnerable. In his own trials, M. Boutigny rubs his hands with soap, giving them a polished surface; and then, at the moment of trial, he dips them in a solution of sal-ammoniac, saturated with sulphurous acid. He has experimented with melted lead, bronze, and cast-iron.

Statistics of Gas-Works.—The number of gas-works in England and Wales is, say 460, in Scotland and Ireland, 170. There are about 45 others, of which 33 belong to private individuals, and the remainder to parochial or municipal bodies. These make a total, for the United Kingdom, of 775 distinct establishments for the manufacture and sale of gas, and which are considered to represent a capital of £10,500,000. The dividends may be quoted at all rates—from none at all, to ten per cent.; the average being a little over five per cent. The quantity of gas produced annually, say, in 1848, may be taken as equal to about 9,000,000,000 (nine thousand millions) of cubic feet; the coal required for that quantity being 1,125,000 tons. After allowing for waste and leakage, the quantity of gas actually sold is about 7,200,000,000 (seven thousand two hundred millions) of cubic feet. These quantities, and the terms in which they are expressed, are but imperfectly understood by persons not practically acquainted with the subject. It may help a little to illustrate the matter by mentioning, that a gas-holder capable of containing the quantity first quoted, would require to be two miles in diameter, and one hundred and three feet in height. The light produced by the last quoted quantity of gas, being that sold, is equal to 342,857,143 (three hundred and forty-two millions, eight hundred and fifty-seven thousand, one hundred and forty-three) pounds, or 153,061 tons of mould candles of six to the pound, and which, at 8d. per pound, would cost £11,428,571. Compared with sperm oil, the quantity of that article required to yield the same light would be 33,133,640 gallons; costing, at 8s. per gallon, £13,253,456. The average price realized by the gas companies, for all the gas sold, including that supplied to street lamps, is, I believe, less than 4s. 6d. per 1000 cubic feet, Taking it at that price, the sum charged for the same would be £1,620,000. The number of men occupied in the manufacture of gas averages about 6000; and more than double that number obtain by it, in various ways, constant employment, making a total of at least 20,000. This does not include, probably, an equal, if not greater, number, engaged in mines and iron-works, and in numberless processes which have had their origin, and are kept in motion, by this branch of domestic manufacture.—*Rutter on Gas-Lighting.*

ENGLISH PATENTS.

Sealed from 23d August, 1849, to 20th September, 1849.

Charles Cowper, Southampton-buildings, Middlesex,—"Improvements in machinery for raising and lowering weights and persons in mines, and in the arrangement and construction of steam-engines employed to put in motion such machinery, parts of which improvements are applicable to steam-engines generally."—(Being a communication.)—August 23d.

Frederick Chamier, Warwick-street, Middlesex, commander in the Royal Navy,—"Improvements in the manufacture of ships' blocks."—(Being a communication.)—23d.

William Edward Newton, Chancery-lane, civil engineer,—"Certain improvements in steam-boilers."—(Being a communication.)—23d.

Alfred Vincent Newton, Chancery-lane, mechanical draughtsman,—"Improvements in manufacturing and refining sugar."—(Being a communication.)—23d.

Thomas Symes Prideaux, Southampton, gentleman,—"Improvements in puddling and other furnaces, and in steam-boilers."—30th.

James Robinson, Huddersfield, York, orchil and cudbear manufacturer,—"Improvements in preparing or manufacturing orchil and cudbear."—30th.

Charles Morey, Manchester, gentleman,—"Certain improvements in machinery or apparatus for sewing, embroidering, and uniting or ornamenting by stitches, various descriptions of textile fabrics."—30th.

A grant of an extension for the term of five years of a patent to George Baxter, Northampton-square, Clerkenwell, Middlesex, engraver and printer,—"For his invention of improvements in producing coloured steel-plate, copper-plate, and other impressions."—30th.

Isidore Bertrand, France, engineer,—"Improvement in protecting persons and property from accident in carriages."—30th.

Onesiphore Pecqueur, Paris, civil engineer,—"Certain improvements in the manufacture of fishing and other nets."—30th.

Malcolm Macfarlane, Thistle-street, Glasgow, coppersmith,—"Certain improvements in machinery or apparatus for the drying and finishing of woven fabrics."—30th.

Alexander Haig, Smith-street, Stepney, engineer,—"An improved apparatus for exhausting and driving atmospheric air and other gases, and for giving motion to other machinery."—September 6th.

Alexander Robert Terry, Manchester-street, Manchester-square, engineer,—"Improvements in the manufacture or preparation of firewood."—6th.

Josiah Marshall Heath, Hanwell, Middlesex, gentleman,—"Improvements in the manufacture of steel."—6th.

Sir John Macneill, knight, Dublin, and Thomas Barry, Lyons, near Dublin, mechanic,—"Improvements in locomotive engines, and in the construction of railways."—6th.

John Hosking, Newcastle-upon-Tyne, engineer,—"An improved pavement."—6th.

Richard Archibald Brooman, Fleet-street, patent agent,—"Certain improvements in draught-horse saddles, harness, and saddle-trees."—(Being a communication.)—13th.

David Stephens Brown, Old Kent-road, gentleman,—"Certain improvements in apparatus or instruments for the fumigation of plants."—13th.

Henry Attwood, Goodman's-fields, Middlesex, engineer, and John Kenton, Bromley, same county, engineer,—"Certain improvements in the manufacture of starch, and other like articles of commerce, from farinaceous and leguminous substances."—13th.

Edme Augustin Chamroy, Rue du Faubourg St. Martin, Paris,—"New system of railway, denominated (helicoide) heliacal railway, and a circular chariot."—13th.

Apoleon Pierre Preterre, Havre, France,—"Improvements in the construction of coffee and tea-pots, and in apparatus for cooking, and in apparatus for grinding and roasting coffee."—13th.

Edwin Heywood, Glosburn, York, designer,—"Improvements in plain and ornamental weaving."—13th.

Robert Griffiths, Havre, engineer,—"Improvements in steam-engines and in propelling vessels."—13th.

Thomas Marsden, Salford, machine-maker,—"Improvements in machinery for hackling, combing, or dressing flax, wool, and other fibrous substances."—13th.

Benjamin Goodfellow, Hyde, Chester, engineer,—"Certain improvements in steam-engines."—13th.

James Potter, Manchester, machinist,—"Certain improvements in spinning and doubling machinery."—13th.

Charles Marsden, Kingsland-road,—"Improvements in traps to be applied to closets, drains, sewers, and cesspools."—20th.

William Edward Newton, Chancery-lane, civil engineer,—"Certain improvements in pumps, and in machinery or apparatus for working the same, which latter improvements are also applicable for working other machinery."—(Being a communication.)—20th.

William Handley, Chiswell-street, Finsbury, confectioner; George Duncan, Battersea, engineer; and Alexander M'Glashan, Long Acre, engineer,—"Improvements in the construction of railway breaks."—20th.

Henry Bessemer, Baxter House, Old St. Pancras-road, engineer,—"Improvements in the preparation of fuel, and in apparatus for supplying the same to furnaces."—20th.

Elijah Galloway, Southampton-buildings, Chancery-lane, engineer,—"Improvements in furnaces."—20th.

Joseph Rocke Cooper, Birmingham, gun and pistol maker,—"Improvements in fire-arms."—20th.

Edward Staite, Lombard-street, gentleman, and William Petrie, King-street, gentleman,—"Improvements in electric and galvanic instruments and apparatus, and in their application to lighting and to motive purposes."—20th.

William Peace, Haigh, near Wigan, Lancaster, and Edward Evans, Wigan, engineers—"Improvements in steam-engines and in pumps."—20th.

Joshia Lorkin, Ivy-lane, merchant,—"Improved instrument or apparatus for beating or triturating viscous or gelatinous substances."—20th.

Benjamin Wren, Yarm, York, miller,—"Improvement in cleansing and treating certain descriptions of wheat."—20th.

David Owen Edwards, Sydney-place, Brompton, surgeon,—"Improvements in the application of gas for producing and radiating heat."—20th.

John Baptiste Vuldy, Mile-end, dyer,—"Improvements in giving a gloss to dyed silk ih skeins or hanks."—20th.

Thomas Griffiths, Islington-row, Birmingham,—"Improvements in the manufacture of tea and other pots and vessels, and other articles made of stamped metal."—20th.

IRISH PATENTS.

Sealed from 21*st August*, 1849, *to* 21*st September*, 1849.

Hugh Lee Pattinson, Scots' House, near Gateshead, Durham, chemical manufacturer,—"Improvements in manufacturing a certain compound, or certain compounds of lead, and the application of a certain compound, or certain compounds of lead, to various useful purposes."—August 22d.

Rees Reece, London, chemist,—"Improvements in treating peat, and obtaining products therefrom."—29th.

Thomas John Knowles, Esq., Heysham Tower, near Lancaster,—"Improvements in the application, removal, and compression of atmospheric air."—September 10th.

Charles Vignoles, Trafalgar-square, Middlesex, C.E.,—"An improved method of preparing or manufacturing peat or turf for fuel."—(Communication.)—10th.

George Fergusson Wilson, Belmont, Vauxhall,—"Improvements in separating the more liquid parts from the more solid parts of fatty and oily matters, and in separating fatty and oily matters; and in the manufacture of candles and night-lights."—12th.

George Nasmyth, Great George-street, Westminster, C.E.,—"Certain improvements in the construction of fire-proof flooring and roofing, which improvements are applicable to the construction of viaducts, aqueducts, and culverts."—18th.

SCOTCH PATENTS.

Sealed from 22*d August*, 1849, *to* 22*d September*, 1849.

James Nasmyth, Patricroft, near Manchester, Lancaster, engineer,—"Certain improvements, and the method of, and apparatus for, communicating and regulating the power for driving or working machines employed in manufacturing, dyeing, printing, and finishing textile fabrics."—August 24th.

Job Cutler, Birmingham, Warwick, gentleman,—"Improvements in the manufacture of metallic tubes or pipes."—28th.

Henry Gilbert, Suffolk-place, Mall East, Middlesex, surgeon,—"An improved mode, or improved modes, of operating in dental surgery, and improved apparatus or instruments to be used therein."—28th.

James Robinson, Huddersfield, York, orchil and cudbear manufacturer,—"Improvements in preparing or manufacturing orchil and cudbear."—29th.

William Chambers Day, Birmingham, Warwick, iron-founder and weighing machine manufacturer,—"Improvements in machinery for weighing."—29th.

Robert William Thomson, Esq., Leicester-square, Middlesex, civil engineer,—"Certain improvements in writing and drawing instruments."—31st.

John Holland, Larkhall Rise, Clapham, Surrey, gentleman,—"A new mode of making steel."—September 11th.

Edwin Haywood, Glusburn, York, designer to Messrs. Thomas and Mathew Bairstow, Sutton, York,—"Improvements in plain and ornamental weaving."—11th.

Robert Plummer, Newcastle-on-Tyne, manufacturer,—"Certain improvements in machinery, instruments, and processes employed in the manufacture of flax and other fibrous materials."—12th.

William Boggett, St. Martin's Lane, Middlesex, gentleman,—"Improvements in heating and evaporating fluids, and in obtaining and applying motive power."—14th.

William Edward Newton, Office for Patents, 66 Chancery Lane, Middlesex, civil engineer,—"Improvements in steam-boilers."—(Communication.)—17th.

John Goodier, Mode Wheel, Manchester, Lancaster, miller,—"Certain improvements in mills for grinding wheat and other grain."—17th.

Alexander Haig, 52 Smith-street, Stepney, Middlesex, engineer,—"Improved apparatus for exhausting and driving atmospheric air and other gases, and for giving motion to other machinery."—18th.

William Henry Phillips, York-terrace, Camberwell, New Road, Surrey, engineer,—"Improvements in extinguishing fire, in the preparation of materials to be used for that purpose, and improvements to assist in saving life and property."—19th.

Sir John Macneill, knight, Dublin, and Thomas Barry of Lyons, near Dublin, mechanic,—"Improvements in locomotive engines, and in the construction of railways."--19th.

DESIGNS FOR ARTICLES OF UTILITY.

Registered from 15*th August*, 1849, *to* 19*th September*, 1849.

Aug. 16th,	No. 1998.	Henry M'Evoy, Birmingham,—"Parts of collars."
—	1999.	Christopher Carney, County Kildare,—"Thrashing machine."
—	2000.	Mapplebeck and Lowe, Birmingham,—"Fire-grate."
20th,	2001.	William Neufville Martin, Newman-street,—"Flower-pot case."
21st,	2002.	Francis Taylor, Romsey, Hampshire,—"Nipple-protector."
—	2003.	John Warner and Sons, Crescent, Jewin-street,—"Solar lamp."
—	2004.	Job Clark and Richard Sidebotham, Willenhall,—"Design for stamping machinery."
—	2005.	George Edward White and William White, Hartley-row, Hants,—"Ventilating brick."
22d,	2006.	Stephen Carlton, 14 Priestgate, Darlington,—"Carriage spring."
23d,	2007.	John Cordingly, Ipswich,—"Bathing boat."
—	2008.	George Babb, 346 Strand,—"The D'Oyley coat-sleeve."
—	2009.	T. W. Ingram, Bradford-street, Birmingham, button-manufacturer,—"Self-calculating steelyard."
24th,	2010.	Thomas Melling, Rainhill Iron-works,—"Improved double-sash window."
—	2011.	William Crane Wilkins, 24 Long-acre,—"Improved spring weighing machine."
27th,	2012.	Rigby and Duckrell, 1 Vauxhall-walk,—"Monastic escritoire slot, slide wax vesta, and chemical light-box."
28th,	2013.	George Aldred, Primrose-street,—"Spindle and spring for a looking-glass."
29th,	2014.	Stock and Son, Birmingham,—"Gas-burner."
—	2015.	Sutherland and Murdoch, Dundee,—"Valve-cock or trap."
—	2016.	Thomas Banbury Randle Ball, Hill-street, Coventry, watch-manufacturer,—"Improved watch."
—	2017.	Alexander Symons and Alexis Soyer, 5 Charing-cross,—"Soyer's modern housewife's kitchen apparatus."
—	2018.	Alexander Symons and Alexis Soyer, 5 Charing-cross,—"Soyer's magic stove."
30th,	2019.	William Satchell, Uppingham,—"Pump and fire-engine."
—	2020.	Henry Holden, Liverpool-street, King's-cross,—"Tailor's measure."
Sept. 3d,	2021.	Hilary Nicholas Nissen and George Phillips Parker, Mark-lane,—"Cash envelope."
4th,	2022.	Andrew Lindsay, Greenock,—"Spindle bearing."
—	2023.	Andrew Lindsay, Greenock,—"Spindle bearing."
5th,	2024.	Neale and Wilson, Grantham, Lincoln,—"Stone-cutting machine."
6th,	2025.	Thomas Stainton and Matthew Stainton, South Shields, Durham, founders and general smiths,—"Windlass."
—	2026.	Augustus Paul and Brothers, Paris,—"Needle-threader and case."
—	2027.	John Duley, Northampton,—"An effluvia trap."
8th,	2028.	Betteley and Co., Liverpool,—"Block sheave."
—	2029.	Charles Minshull, Weston-street, Southwark,—"Imperial hame."
15th,	2030.	William and Charles Eley, Old Bond-street,—"Cartridge-case."
17th,	2031.	Frederick Gotto, Dover, surveyor,—"Self-discharging effluvia trap."
18th,	2032.	Charles Chapman Clark, Reading,—"Self-acting water-closet."
—	2033.	Isaac Benjamin, Old Change,—"Acme brace front."
19th,	2034.	Joseph Bell, of the firm of Cort and Bell, Leicester,—"Effluvia trap."
—	2035.	C. Gore, 3 New Charles-street, City-road,—"Gas-exhauster."
—	2036.	Foster, Porter, & Co., Wood-street, Cheapside,—"Spring muffler."
—	2037.	Charles Maschivitz, Birmingham,—"Letter stamp."

TO READERS AND CORRESPONDENTS.

A synopsis of the leading contents of the eighteen numbers of the *Practical Mechanic's Journal*, already published, has just been issued. It contains a list of the most valuable and interesting subjects which are to be found in this work, with the accompanying copper-plate engravings, arranged in order, under the heads of the respective numbers in which they have appeared. A classified statement of this kind, will, it is presumed, be found useful for general reference, or as an aid in the obtainment of particular parts of the work, which may contain any needed information. The synopsis may be had from the booksellers; or free per post on receipt of *one* stamp.

Mr. Begg.—The suggestions are in some respects good, and if the modifications do not take up too much room, or interfere with our plan in other respects, we may probably adopt one of them. He may rely upon it that we have much pleasure in receiving suggestive opinions of any kind.

Fell's Motive Power.—We shall notice this invention next month.

Received.—"Wilkins' Weighing Machine;" also, "Real Civilization."

Mr. Watson.—We have addressed a note to him on the subject of his inquiry. Chrimes' Fire-Cock *was* described at page 209, vol. i. Practical Mechanic's Journal.

S. A., Wiltshire.—Davies' Gas Exhauster, described at page 266, vol. i., will, we think, answer his purpose as a blower. We saw a large one last week in Birmingham, fitting up for a smelting furnace. It gave a *steady* blast equal to 1½ inches of mercury, and if driven at a higher rate, the pressure might have been considerably increased. With such a blower as this, he might blow directly into his furnace. The proper speed for the blower must be a matter of experiment, to suit it to the work to be performed. Cupolas differ so much in proportions, that unless we had a sketch of his before us, we could not give any practical statement as to the size of twyeres. For the diameter mentioned, we should say from 4½ to 5½ inches. From such a cupola, he ought to get at least twice the amount of iron he mentions per hour.

ENVELOPE MACHINERY.—RÉMOND'S IMPROVED FOLDING MACHINE.

(*Illustrated by Plate* 37.)

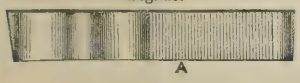
With the full development of the modern system of penny postage, and the consequent enormous extension of commercial and domestic correspondence, a new branch of manufacture of a very trifling article has sprung up, to an extent which all must admit to be startling. The general observer would hardly infer from the contemplation of so simple a contrivance as a letter envelope, that in its production are involved the use of many costly machines, and the work of hundreds of hands; yet it is computed that the weekly manufacture of these articles amounts to some fifteen millions. Originally of French invention, the envelope has gradually superseded—for most purposes—the ordinary folded letter, as presenting many conveniences, and an elegance of appearance, which, in the latter, are entirely wanting.

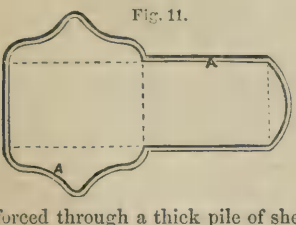
In 1843, about 330,000,000 letters were posted in Great Britain; and, calculating from ascertained data, we are probably not exceeding the estimate, by computing the annual number at the present time at 400,000,000. But this is only one branch of the letter and parcel system; for, in addition to the distant transmissions which must pass through the post-office, the bulk of invitations, cards, private notes, invoices, and accounts, now involve the use of envelopes, and these do not of necessity pass through the post-office. Again, the large companies arising out of the modern practice of commercial science—for commerce *does* demand some consideration as a science—as railway, insurance, and other joint-stock combinations, are large consumers of envelopes.

Previous to the introduction of the penny postage plan, the envelope was almost unheard of; for, owing to the peculiar system regulating the postage charges, all letters so enclosed were subject to a double rate, as a double letter. The alteration on this head, however, gave a powerful impulse to this mode of enclosure, and, in later years, its adoption has been universal. Its convenience is obvious, when we remember how it facilitates the transmission of shapeless slips of paper, memoranda, or the hundreds of minor objects, which are daily despatched under the cover of a sheet of paper; its elegance is undoubted, for it reduces all figures to one standard of regularity and neatness.

In the earliest stages of the invention, the paper blanks were cut out, and the subsequent folding performed entirely by hand; but the necessity of a prodigious increase in the power of production, speedily led to the employment of mechanical means for the entire manufacture. One of the first of these improvements was introduced by Mr. G. Wilson, of London, who, in 1840, under his patent for "An improved paper-cutting machine," applied a most ingenious plan for cutting out the blanks. Many envelope-makers use this machine now; but others employ a hollow cutting die, cutting through about 250 sheets of paper at once; but the cutter being made very thin, to give an easy cut, generally springs under pressure, and the blanks thus become unequal in size, easily detected when the folding operation comes into action.

Fig. 10.





As an example of the class of cutting die employed, we have engraved two views of one invented by Mr. E. Morgan, in 1845. Fig. 10 is a sectional elevation of the die, and fig. 11 a plan. It is simply a knife, shaped to the contour of the envelope blank, A being the sharp edge. This is forced through a thick pile of sheets by a convenient press, so as to produce blanks agreeing in shape to the interior of the two lines in fig. 11. This shape, it will be observed, is not one now in common use, but it serves as an example of some of the attempts which have been made to give additional security, and probably a greater appearance of style. The cut pieces are gummed on one side, at the ends of each flap; and when folded, as indicated by the dotted lines in the plan of the cutter, the long narrow part adheres to one end of its counterpart, forming the back, and the remaining pair of flaps fold down upon it. This shape of envelope has, for many reasons, never come into ordinary use.

In 1845, a folding machine for completing the envelopes from the blanks was invented by Mr. Edwin Hill, of the stamp department, and Mr. Warren De la Rue, jointly, and is now worked in the extensive establishment of Messrs. De la Rue, of Bunhill Row, London. Its rate of production is stated to be 42 folded envelopes per minute; or, for a day's work of 10 hours, 25,200. The blanks are laid by hand upon a table carrying a metal frame, the interior of which exactly corresponds to the size and shape of the finished envelope; and immediately over this is a box or plunger, which, fitting to the interior of the frame, is caused to descend upon the paper blank when laid over it, thus creasing it on all the four sides, as will be understood on examining a partially-opened envelope; the box then opens to admit of a partial folding. In this condition the blank has simply been creased, and the four flaps stand up at right angles to the plane of the sheet. Before the creasing-box is entirely raised, two of a set of folders, placed one on each of the four sides of the frame, come forward, and press down the two flaps corresponding to their situation; and the remaining pair of folders come into action to press their two flaps after the other portion of the plunger is raised. These movements complete the envelope, by turning down the right-angle flaps to the plane of the sheet, and the next step is to remove them from the folding-frame. For this purpose, two finger-shaped projections of caoutchouc are made use of; and, owing to the strong adhesion existing between this substance and paper, the folded envelopes are quickly removed as fast as they are produced. The twenty-two movements required in folding each envelope are performed rapidly and noiselessly, principally by various adaptations of cams. Prior to Messrs. Hill and De la Rue's invention, the only facilitation of manual labour in folding was obtained by the use of a species of tool, which partially creased the blanks, leaving them to be turned up and finished by hand. Compared with "the results of machinery," the hand labour, although in itself an astonishing instance of practical dexterity, is inordinately slow. Girls are always employed in this work; and a first-rate hand can fold and gum for use from 3,000 to 3,500 per day, or from 5 to 6 per minute, the average performance being from 2,500 to 3,000. To arrive at this perfection, at least six or eight months' practice are required.

By another comparative statement now before us, we find that, in unstamped envelopes, hand labour, 6 per minute—10 hours per day = 3,600; the work of one girl. Stamped envelopes, hand labour, $4\frac{1}{6}$ per minute—10 hours per day = 2,500, a day's work; the time being divided into 7 hours for folding and gumming, and 3 for stamping.

Our plate 37 exhibits, in very full detail, an improved folding machine, patented, during the present year, by M. A. F. Rémond of Birmingham. In this machine some ingenious appliances are introduced, whereby atmospheric pressure is employed to facilitate the feeding in of the blanks to the folding apparatus, and the secondary folding action of the flaps in connection with the creasing plunger.

Fig. 1 is a side elevation of the machine, partially in section. Fig. 2 is a corresponding view at right angles to fig. 1. Fig. 3 is a vertical section of a portion of the machinery, taken at the dotted line, A B, in fig. 1. Fig. 4 is a horizontal view or plan of the folding table, with the details of the apparatus for receiving the blanks preparatory to folding. Fig. 5 is a transverse section, taken at the dotted line, C D, in fig. 1. Fig. 6 is a plan of the feeding-slide, N N, in figs. 1 and 2. Figs. 7, 8, and 9, are details of the guide apparatus for the several movements on the main shaft, A, of the machine.

The arrangement of the mechanism is such, that a quantity of blanks of the required size being placed on the feeding table, each will be taken up singly from the pile, and fed into the folding apparatus by means of an instrument, in which, at proper intervals, a partial vacuum is formed, whereby each sheet is sucked up against the surface of the fingers for conveyance to the folder.

The first step of the process of folding is accomplished similarly to the mode hitherto adopted, and generally explained, in reference to Messrs. De la Rue's machine—that is, the flaps of the blanks are bent to a right angle by the same means; but a novel arrangement is introduced for the performance of the secondary fold. The bottom of the creasing frame or box is perforated, so that the passing back of the plunger leaves the blank within the recess, with its four flaps standing upright; and here the second application of the atmospheric action comes into play, for the purpose of giving the flaps a preliminary inclination inwards, in order to fit them for receiving the flat folding pressure of the return stroke of the plunger. To this end the sides of the folding-box are perforated, so as to allow streams of atmospheric air to be forced against the outsides of the flaps; so that, on the descent of the plunger, they will all be folded down at once, the interior and under surface of the plunger being suitably formed to cause the flaps to succeed each other in their proper order. In addition to this, certain contrivances are adapted for stamping the outer flaps with an embossed or perforated device, and also for gumming the lowest flap as a fastening for the completed envelope.

A, Is the main driving shaft, which gives motion to the machine. It carries at one end a fast-and-loose driving pulley, and at the other a fly-wheel, to assist in regulating the movement; and its intermediate portion is fitted with seven cams, for communicating motion to the different working parts. B, Is the folding-box, or recess, in which the folding process is performed. It consists of four side-pieces, at the angles of which are projections, C C, between which the blanks are successively fed, so that they may be correctly placed, and held during the action of the plunger. D, Is the door or moveable bottom of the box, hinged at one end, so that when an envelope has been folded in the box, it may be discharged below; it is perforated with numerous holes for the escape of the air, as the blank is forced down, and is kept closed by means of a lever, E, which is actuated at the proper intervals of time by means of the cam, F, on the main shaft, giving motion to a slide, G, of which there are seven, all alike in construction, in connection with the same number of cams. The slide works between two fixed guiding surfaces, H H, as detailed in figs. 7 and 8, and has at its upper end a small anti-friction roller, kept up in contact with its actuating cam by the elastic tension of a band of vulcanized india-rubber. The lower end of the slide presses on the tail of the cranked lever, E, the other end of which rests against the under surface of the moveable door, D, so that the latter is kept closed during the proper portion of the revolution of the main shaft. The feeding action is accomplished by the exterior cam, K, on the shaft, giving motion—as before explained with regard to the cam, F—to its slide, L, which is attached to the shorter arm of the cranked lever, M, the opposite arm of which is jointed by connecting-rods to the feeder, N. This instrument is carried upon a slide, having dove-tailed edges, moving between fixed guiding dove-tails, at O O. It consists of two hollow fingers, P P, each having an opening on the under side; the interior of the fingers opening into the hollow portion of the slide, shown by dotted lines, allowing of a partial vacuum being obtained within the fingers when the exhaust movement comes into use. A flexible tube, Q, of vulcanized india-rubber, is attached to the under side of the slide, the opposite end being connected with the bellows, R, which receive motion at the required intervals from the cam, S, acting on the slide, T, in connection with the bent lever, U, carried by a pillar at the back of the machine. The longer end of this lever is jointed by a connecting-rod, V, to the front plate, W, of the horizontal bellows, running on guide-spindles, X X. In this way, when the under side of the fingers comes upon the top of the pile of blanks at Y, the exhausting action is brought into play, and the top sheet is carried over to the top of the box, B, for deposit, with its angles fitting the corner guide-pieces, as in plan at fig. 4. At the termination of the outward stroke of the bellows, the sheet is separated from them by the action of a valve in the bellows, opening outward at the commencement of the return stroke. The platform, Y, carrying the pile of blanks, is made to rise and fall, to suit the feeding action, by a mechanical arrangement worked from the cam, Z. This cam actuates a slide, *a*, from which an arm, *b*, descends, for connection with the long lever, *c*, at the bottom of the framing, the opposite end of which is jointed to a projection on the vertical spindle, *d*, of the platform. To compensate for the continual decrease in the height of the pile of blanks, so that the upper one may always come in contact with the lifting fingers, when the platform rises, an india-rubber spring, *e*, is added, its action being to keep up the platform in contact with the fingers, when permitted to do so by the actuating cam. As everything depends upon accuracy of set, it becomes of the first importance to place the blanks in the exact position intended; and to facilitate this, four projecting arms, or guides, *f f*, are formed on the top of the platform, agreeing, as in the angle-pieces of the folding-box, with the angles of the flat blanks.

As the blanks are fed into proper position, the folding plunger, *g*, comes into action. This is a hollow rectangular metal frame, carried by a slide, *h*, receiving motion from the cam, *k*. It has in its interior a set of three projections, which, in the secondary movement, act on the separate flaps, folding them all down at once, when they are held in the required inclined position by the atmospheric side currents, as previously detailed. The inclined projections are essentially necessary, in order that the flaps may be folded down in their proper relative positions; the projection, *l*, pressing on one of the side flaps, causes it to be folded first; afterwards the projection, *m*, acts upon one of the ends, whilst the third, *n*, carries down the opposite one, the final folding being completed by the under edges of the plunger, which gives a sharp pressure to the initiatory fold of the whole series. By suitably setting these projections, any order may be given to the flaps—thus, if the two end ones do not overlap each other, they may be folded down together by equal projections. The detailed figures, 12 and 13, exhibit two intermediate stages of the plunger's folding action. Fig. 12 is a longitudinal elevation of the plunger, and the top of the folding-box, in the position taken up after the first action of the former, the side air-passages for inclining the flaps being at *o o o*. Fig. 13 is a longitudinal section of the same parts, taken just as the plunger is about to descend in its secondary movement to give the completing fold.

Fig. 12.

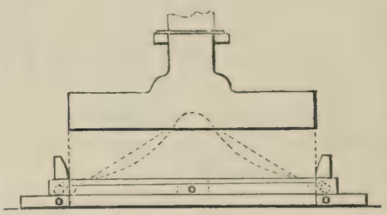
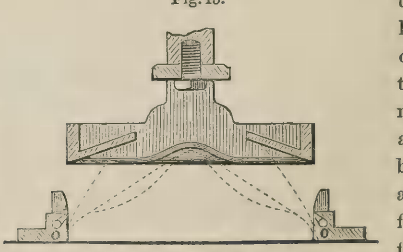


Fig. 13.



1-4th.

The necessary atmospheric side pressure on the flaps is obtained from the inclined air-pump, *p*, the piston of which is driven by a crank-pin on the fly-wheel; and a tube, *q*, conveys the forced air from the bottom of the pump to a hollow channel passing all round the edges of the folding-box, as dotted in the plan, fig. 4, whence the orifices already pointed out, open inwards to the box. For the application of gum, or other cementing fluid, to the lowest flap, to secure the three stationary ones, a fountain is placed at *r*, from the bottom of which, two tubes, *s s*, branch out to the two flat tubular receptacles, *t t*, enclosed in a vessel, *u*, the supply being regulated by a stop-cock before the junction of the two supply

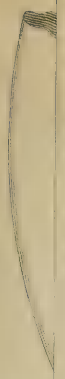


Fig. 2.

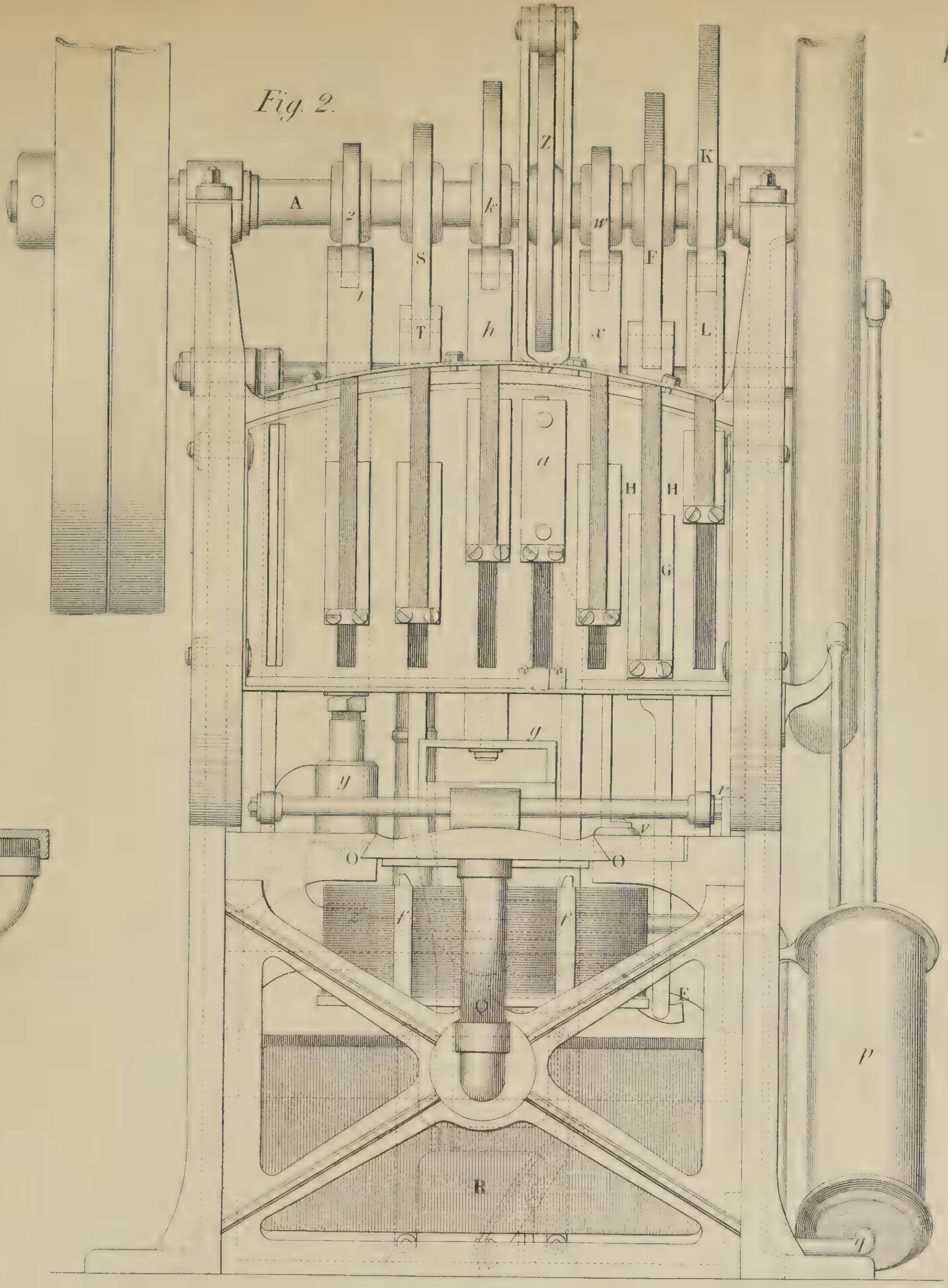
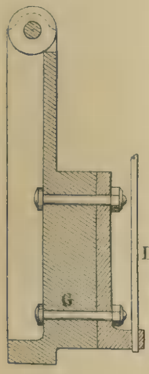
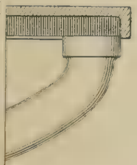


Fig. 7.





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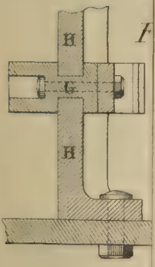


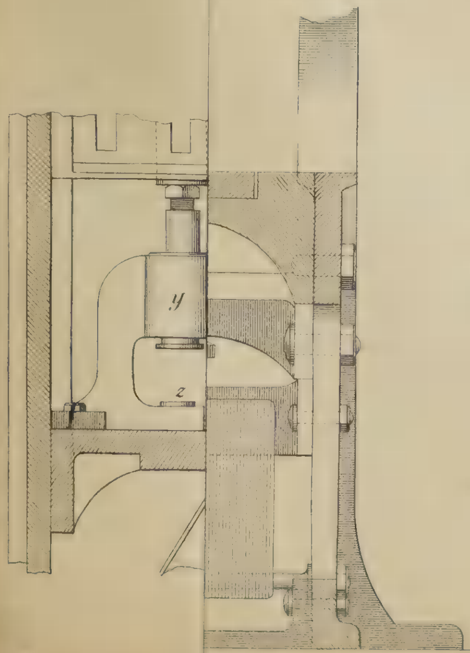
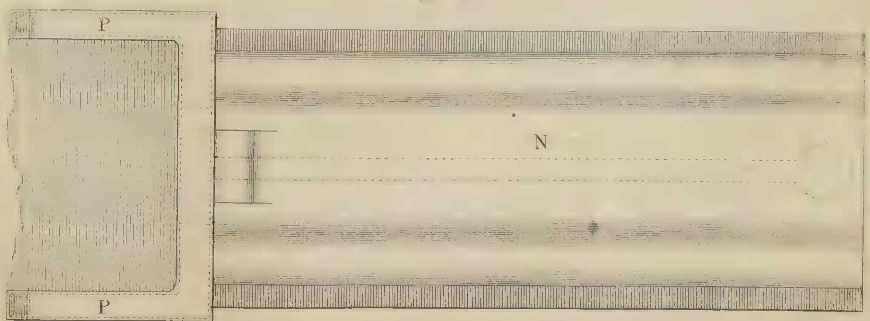


Fig. 6.



RÉMOND'S ENVELOPE MACHINE.

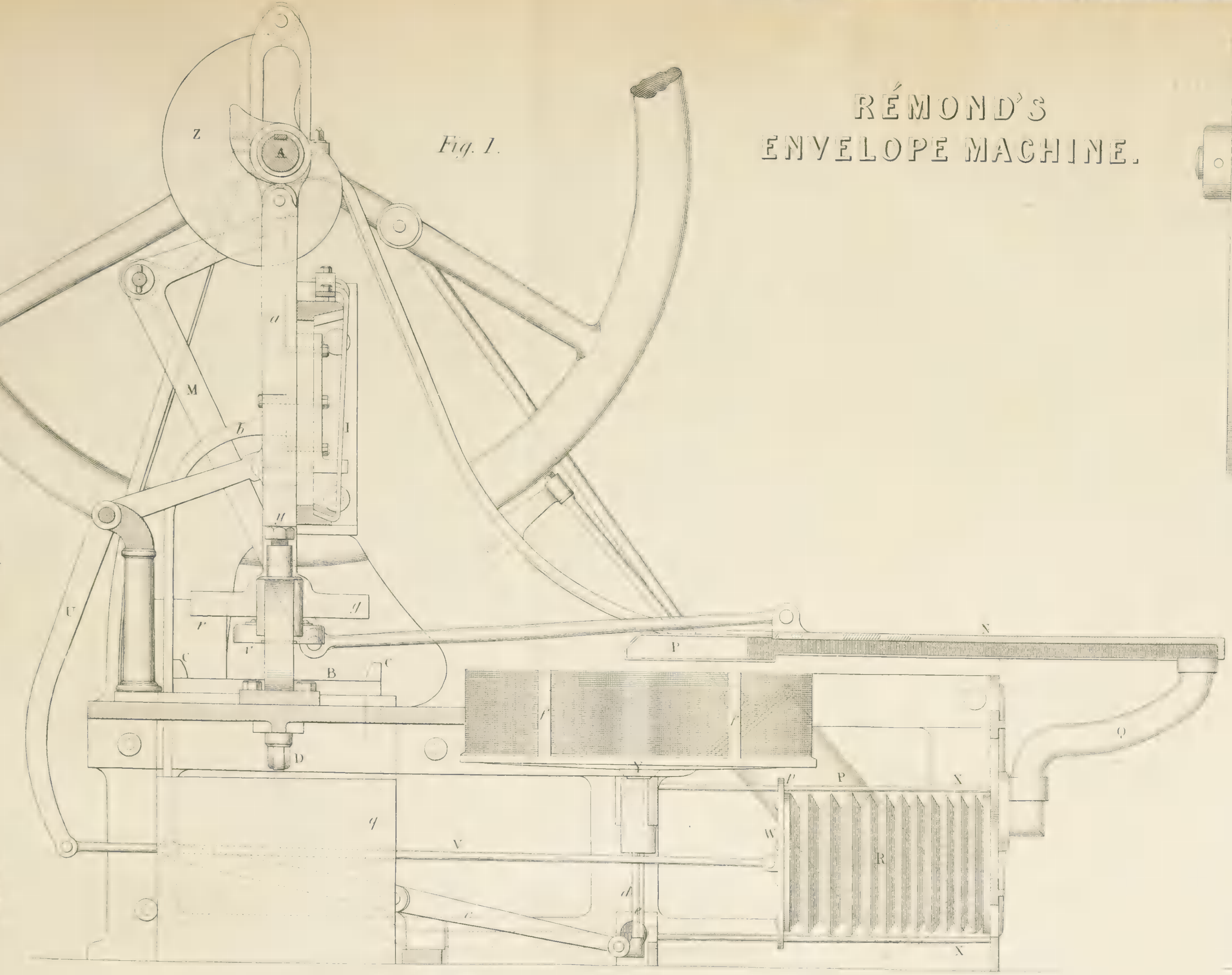


Fig. 1.

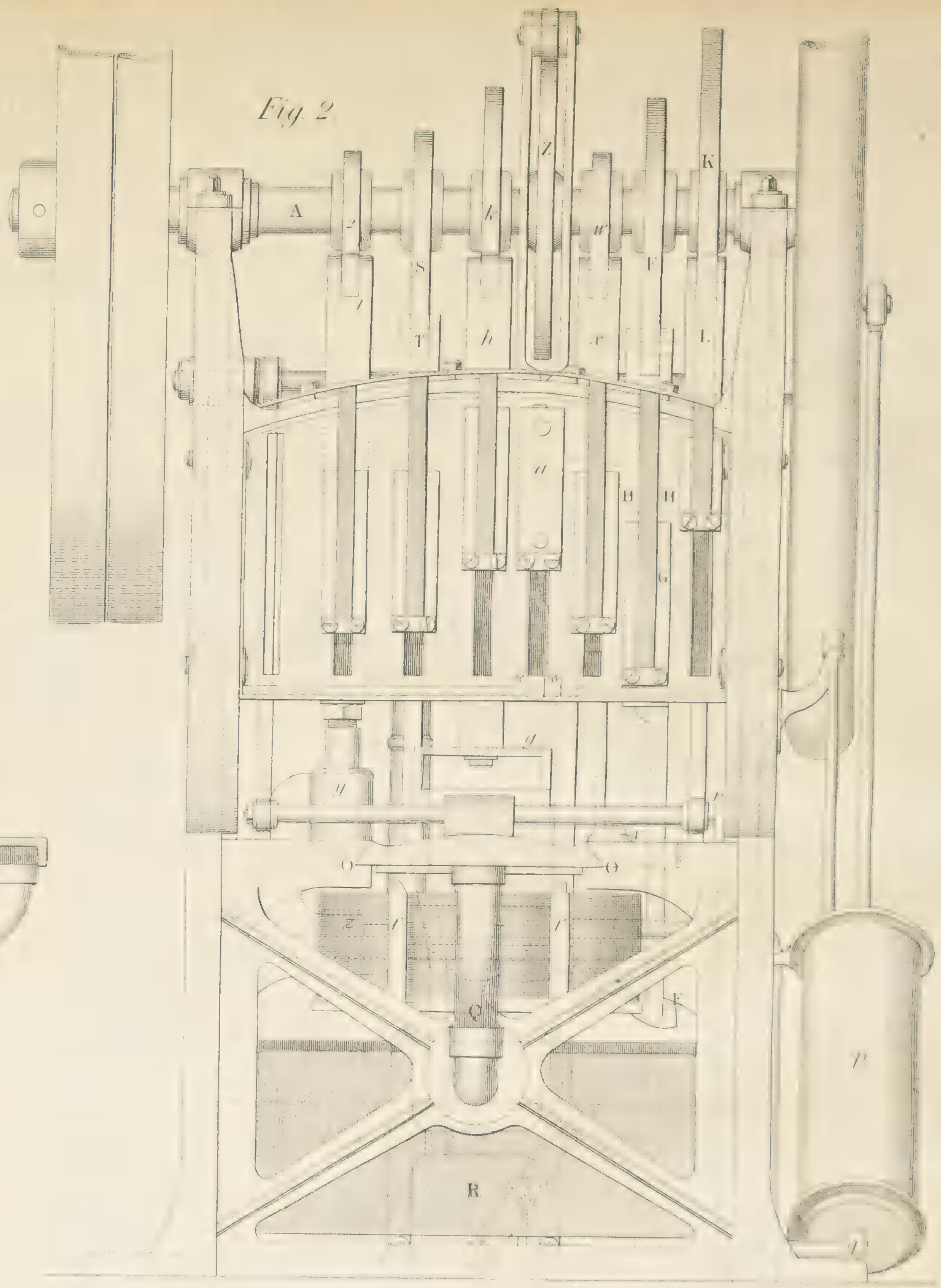


Fig 2.

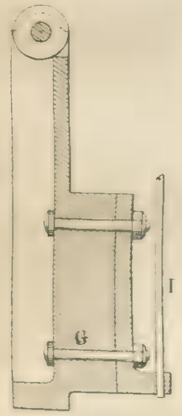


Fig. 7.

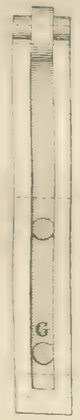


Fig 8.

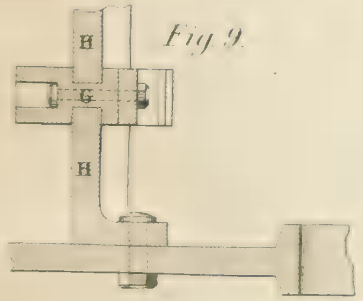


Fig 9.

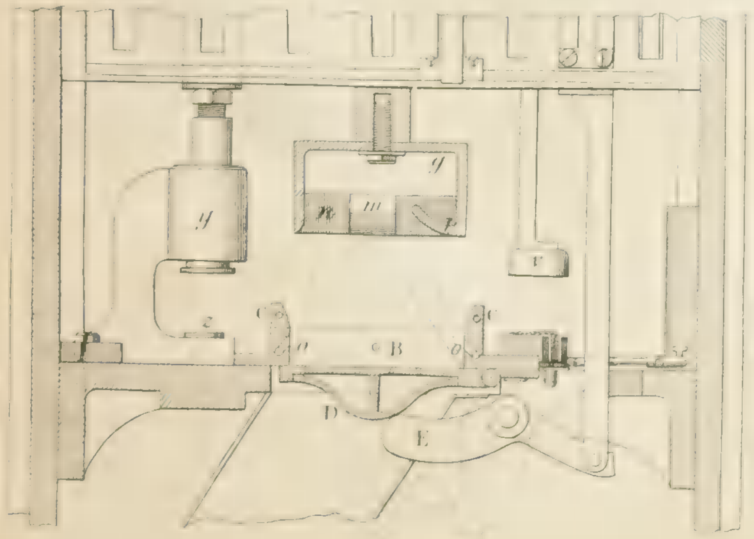


Fig. 3.

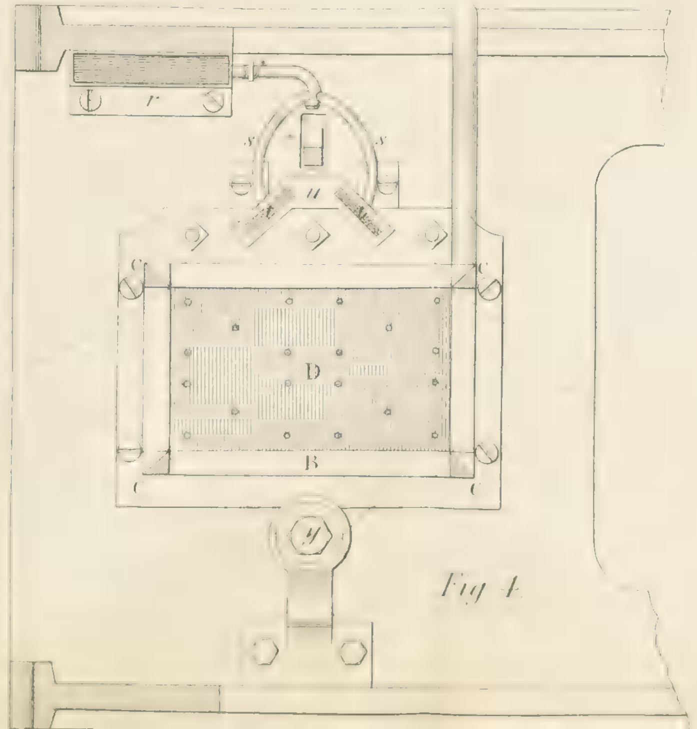


Fig 4.

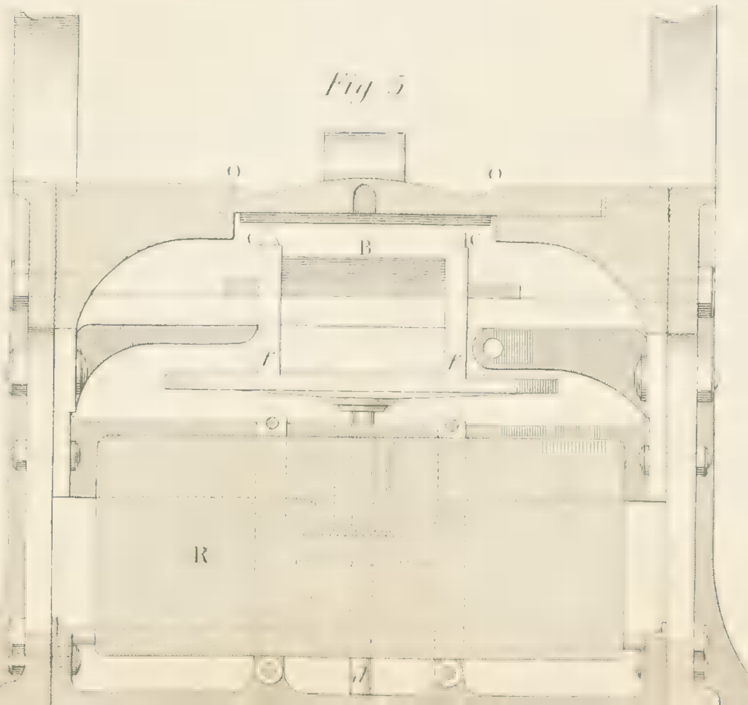


Fig 5.

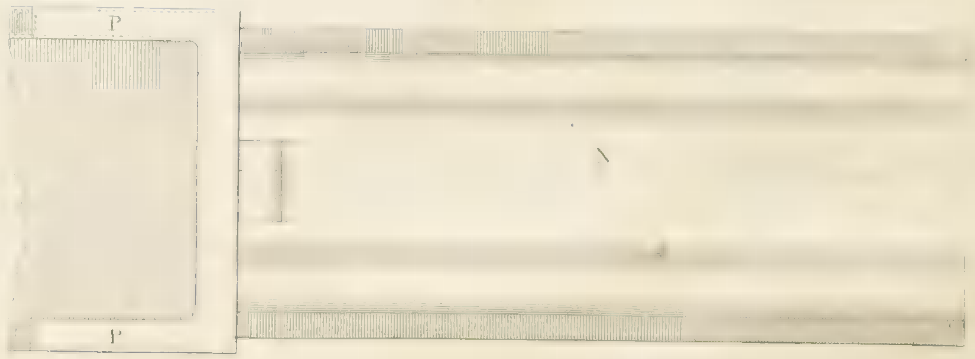


Fig. 6.

branches. The gumming action is performed by pieces of sponge placed in the upper ends of the flat tubes, *t*, which, standing slightly above their upper edges, the presser, *v*, descending just before the plunger, presses the edges of the lowest flap upon the sponge, as clearly illustrated in the plan view. This presser receives its motion from the cam, *w*, acting on the slide, *x*, to which the presser is attached. If it is intended to stamp or emboss the outer flap with an embossed or perforated device, dies are applied as at *y z*. The die, *y*, being attached to a slide, 1, acted on by the external cam, 2, the stamping action takes place just before the descent of the plunger.

This machine, or rather a modification of it, we saw working at Birmingham, on our late visit thither. It produces easily 60 envelopes per minute, or 36,000 per day, completed, gummed, and stamped, and might probably be worked faster. As at present practised in other modes of production, the folding, gumming, and stamping are all separate processes; and as, at each of these operations, every single envelope must be separately handled, we may form a tolerable conception of the economy gained by the use of M. Rémond's machine, as the most improved contrivance of earlier date saves no more than one-third of the manual labour. The isolation of the different stages of manufacture, consequent upon the employment of manual labour, adds immensely to the cost of production, the loss mainly arising from the mere removals from one process to another. In hand-stamping, a child will perhaps get through 8,000 or 9,000 per day; and then there must be an assistant to turn the tops where the stamp has been placed, and count them into parcels.

Since the first anticipations of the value of the envelope for general consumption, of course very many modifications have been introduced. In 1844, Mr. Wilson, the inventor of the cutting machine, hit upon the ingeniously simple mode of economising the paper in cutting out the blanks, by cutting the original web of paper diagonally across its width. Formerly, when the web was divided longitudinally, and then by transverse cuts at right angles, the rectangular sheet thus formed, when cut up into diamond pieces for envelopes, suffered considerable loss in the reduction. By Mr. Wilson's plan this was avoided, as the transverse cuts being all made diagonally, each blank fitted exactly to its neighbour, and this source of loss was removed. In 1846, again, Mr. Chas. Chinnock, of London, obtained a patent for some contrivances for the obtainment of greater security of enclosure, by applying the ordinary postage stamp, or other adhesive labels, so as to become a fastener for the edges of the paper forming the envelope. In one of his arrangements, a small hole, somewhat less than the area of a postage stamp, is punched at the right-hand corner of the address side, so that, when the stamp is put on, it adheres not only to the edges of the hole, but also to the turned-in edge produced in the end-fold of the envelope, as well as partially to the enclosed note. Thus the enclosure cannot be removed without leaving detective marks. According to another mode, the patentee punches holes of various sizes through the parts of the envelope where the seal is placed —in some cases placing a bit of blotting paper beneath, this being for the purpose of securing the whole by the seal. In another arrangement, the envelope is the same shape as that now generally used, having four triangular flaps, meeting in the centre for the seal. In the ends of three of these flaps are small holes, each one a little different in size, so that when folded the smallest hole is the lowest, and the largest the third in the layers, whilst the fourth is blank, the wax below which not only secures all the flaps, but adheres also to the enclosure. When a piece of blotting paper is placed below the holes, as in another modification, any attempt to open the letter would involve a tear.

The ordinary four-cornered envelope, fitted to form what M. Rémond calls the "Detector," appears to answer all the requisites of security and elegance. The sealing-flap is embossed with some device, the centre of which is perforated in any ornamental way, and a coloured wafer is placed beneath it, showing through the perforations like a coloured device. When this is fastened in the usual way, a very slight examination serves to show whether or not it has been tampered with. If the wafer is used, and hot water or steam has been employed to soften it, its brilliancy will have entirely disappeared; and if attempted to be cut through, its substance is so thin, that, either wet or dry, the chances are, that the minute integuments of the star, or other device, will be broken or disarranged. This species of seal is besides ornamental, and for general purposes may supersede the now common plan of colour-stamping.

Whilst we write, specimens of a peculiarly-contrived envelope, invented by Mr. J. B. Winder, of Birmingham, and registered a few days ago, have reached us. The novelty consists in so forming the face of the envelope, as to enable any one to ascertain the name and address of the writer of the enclosed note, without opening it, at the same time affording a provision for the direct return of the missive to the writer, should the party, to whom it has been addressed, not be found. A short and narrow slit is made in the face of the envelope, near the centre of its upper edge. This slit is in the line, and, indeed, forms a portion of a ring of minute perforations in the paper, enclosing an area of about $\frac{3}{4}$ of an inch, or as much as will conveniently contain an address in very small characters. On the inside of the envelope, and directly behind the ring or device, is placed a slip of paper, cemented on one side just over the slit, so as to form a short flap, slightly larger than the ring before it. On the front of this flap, looking on the face of the envelope, is written or printed the address of the writer; and when, on such an occasion as that which we have mentioned, it is necessary to ascertain the address of the sender, the thumb nail is inserted in the slit, and the piece of the envelope face enclosed within the perforations is thus torn out. The perforations being small, and set very close together, guide the tear, so as to take out only the piece of paper which they enclose, when the writer's name, as written on the flap beneath, becomes clearly visible, and answers as a re-direction for the letter.

We are sorry to raise any objection against so ingenious an example of envelope mechanism; but it appears to us, that the ordinary plan of embossing the envelope with the name and address of the writer answers all the conditions to which this arrangement aspires—in a more elegant, simple, and less costly manner. It is true, that in Mr. Winder's scheme the name of the writer is screened from public view until it is absolutely required; yet, in nine out of ten cases, this would not be deemed important.

NOTES OF TRAVEL ALONG THE SOUTH DEVON RAILWAY INTO CORNWALL.

Having lately wandered in search of health into two of the western English counties, Devonshire and Cornwall, I have ventured to send you a few random notes of my journey; not from any false idea of their importance, or even of novelty to several of the readers of your widely circulated Journal, but in the hopes that they may prove interesting to many, as helping to realise the habits of the men of "Land's End," to those who live so much nearer "John o' Groat's House."

The ride along the South Devon line was a memorable one. To say nothing of the high fares, which only inconvenience those who, like myself, find the knots in their purse-strings very troublesome to undo, when frequent and heavy calls are made upon them; neglecting all such trashy and ignoble considerations, as well as the unpleasant feeling—it *can't* be fear—which, in spite of my engineering experience, I always find to be troublesome upon long trunk railways with only a single line of rails, I still find crowds of notes worthy of remembrance. First, there are the curves—and such curves! and then there are the inclines!! and then, above all most wonderful, there are the very queer combinations of both curves and inclines!!! I cannot refrain from calling to mind, with all its concomitant queer notions, one particularly nice sharp curve, most picturesquely placed just in the middle of a rather steep incline—even for the South Devon. We descended at a regularly rattling pace a little late—*i.e.* only an hour, they say that's nothing on the South Devon—and making up for lost time downhill, steam kept on, if anything longer than possible, and looking out of the carriage, the end of the railway was to be seen nowhere, but in the place where most persons would have looked for it, was a very respectable Devonshire precipice. Arriving on its brink, expecting to be sent over flying as a matter of course, the rails, like the Irishman's gun, were made to shoot sharp round the corner; or as if the engineer, like the designer of Sir Hugh Middleton's new river, which supplies a large part of London with water, could not help going downhill; so he guided his route zigzag fashion, to prevent anything from running down too fast, or from getting to the bottom without having had quite enough of it. In my own case, the broad guage made an instant convert, for thanks to the Dutch build, and the firm substantiality of the broad base, we did *not* upset; and in spite of the grating of the wheels against the rails, their tremendously vicious attempts to find "a screw loose," and the wave-like rocking of the carriages, we arrived safely at the foot of the hill—I had nearly said mountain—and stopped at a station which afforded a little time for recovering one's usual equanimity. I have travelled up and down several very steep railway inclines, particularly on the coal and slate lines, where the gravitating system of full waggons pulling up the empty ones is fully carried out; but it was reserved for the South Devon incline, and the knot that is tied in the middle of it, to teach me the practical power of fascination. As we commenced the descent, I happened to put my head out of the window, and though full of really very curious imaginings—of course they couldn't be fears—yet was compelled to gaze on and on, and taste all the fancied dangers twice over.

We afterwards made ample amends for our race downhill; like a seesaw or a pendulum, having gone down, we had to go up again. We were not quite like the unwilling lad, who, in walking to school, went back two steps for every one he went forward, and only arrived at his destination by dint of walking backwards; no, we went on—until we stopped. This happened, notwithstanding the aid afforded to our locomotive by very ingeniously contrived stampers, or ground pushers,—not the antiquated and exploded patents of 1829, by Messrs. Curtis and others, but the far more venerable and useful apparatus of human legs. Enginemen, guards, and a stray policeman, all put their shoulders to the wheel, presenting a very novel and instructive sight, having only one drawback in the eyes of the lovers of poetical justice, in the consideration, that this very patient industry did *not* meet with its reward; for the train stopped. It was at length cut into I know not how many bits, which, one by one, were dragged over the "Slough of Despond." Absurd as such a scene may appear, it is nevertheless true, and excepting the absolute stoppage and piecemeal dissection of the train, the same scene was repeated on the Great Western Railway on my subsequent journey from Bristol to London; guards, stoker, pointsmen—it was near a station—policemen, and other hanging-on officials, all helped the locomotive; pushing in the fashionable railway attitudes, to urge on a train to London, and all this in fine dry weather and the open day! They certainly may lay claim to the honourable distinction of being curious accidents in railway experience; and unless I am misinformed, the companies have lately allowed these wonderful performances to be frequently and freely exhibited to the passengers who have paid their fares: the result may satisfy some of the directors', if not the shareholders' expectations.

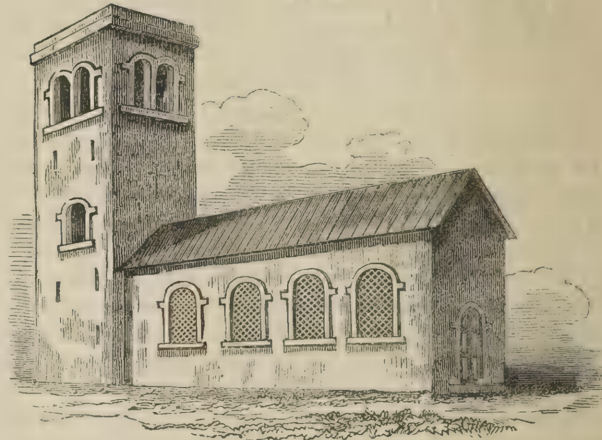
Verily, the South Devon Railway aboundeth in things most marvellous; for pray, what would you think, Mr. Editor, of building a grand railway station, in a nice, neatly, architectural prettiness, windows in quaint casement-leadings to match, providing first, second, and third class waiting-rooms, and then — locking the door most scrupulously against all earlier arrivals than those who may be there within five minutes of the time set forth in the bills? Probably the very worthy directors may wish to enforce public, if not railway punctuality, by precept and authority—I should have said example—but the remembrance of the hour-and-a-half-behind-time-train prevents my being sufficiently unprejudiced to do so: should your readers think otherwise, they can easily remedy the defect for themselves. However praiseworthy the spirit of the law and the kind intentions of the directors, I can assure you, Mr. Editor, that the practice is far from agreeable, when a stranger arrives too early, a little heated and tired by his walk, on a misty dampish morning, only to find the door locked in his face, and having nothing to do but to read the words "waiting-room," and puzzle his brain in vain for their signification, and his ingenuity for the utility of the rooms themselves. He may exclaim as Hamlet did against the old-fashioned and noisy Danish accompaniment to regal toast-drinking—

> "That to my mind—though I were native here,
> And to the manner born,—it is a custom
> More honoured in the breach than the observance."

Well provided as the stations are with waiting-rooms, which, by the company's absurd regulations are almost useless, they are as ill-provided as absence of accommodation can make them, with the requisite adjuncts, not only for the use of the traveller either in transit or expectant, but also for the clerks, porters, pointsmen, and other officials. Let unbelievers go and see for themselves; but if they should select Teignmouth for inspection, and be persuaded to stay a few days to inspect the really beautiful surrounding scenery, do not let them be so far overcome by the seductive ideas of clean linen, as to trust their garments with the Teignmouth washerwomen, unless they are fully prepared to have them returned after being dipped in dirty water, dried in the ash-pit, and ironed with the poker. A worse fate could not have befallen some of my unfortunate articles, which I had been so weak-minded as to intrust to their care. I must, however, in justice confess, what I have no doubt will find ready credence, namely, that I did not try the skill of all the other washerwomen; had I done this, my dirty-clean clothes might have experienced another fate,—some well-versed victims *have* hinted it might have been worse, though the sending of clean—at least washing-paid-for clothes, to be washed and paid for over again at the next town we come to, is nearly as bad as it can be.

But I have not yet washed my hands of the South Devon, for I should like to have your readers' private opinion of the use of a building of which fig. 1 is a correct representation. Possibly they will at once exclaim, "Oh! it's a church," and feel rather astonished at the inquiry, and quite satisfied as to their correct observation. So did I, when my attention was called by a companion to such a building close by a station; and, if it must be confessed, I considered it such a very self-evident affair, that my powers of perception rose high in comparison with my neighbours'. At the next station, another building, bearing a strong family likeness to the foregoing, procured a rather longer survey from the carriage window, and the exclamation, "It *must* be a church." The next member of the same family, at parting, was saluted with the phrase, "It *can't* be a church;" and another building, "ditto repeated," brought me to my senses, and I condescended to ask the question, "What *is* that place?" The answer was ready—"The Stationary Engine-house." The murder was now out, and the sphinx, for once, was disappointed of her prey. The past atmospheric history of the line had been completely forgotten, for the accustomed "piff-paff" of the locomotive, the novelty of the company's regulations, and the exceeding beauty of the scenery that was not made up of cuttings and tunnels, had quite driven all remembrance of the airy, or less than airy, vacuous scheme out of my head. But there, in silent majesty, and "in memory of," stood "Brunel's follies," as they have been called by the unfortunate shareholders, in these their days of trials—both chancery and common law; though I have just heard the report, that these "preference squabbles" are quashed by a private arrangement. Who could look without emotion upon these splendid mausoleums? well-paid-for memorials of the defunct plan of sticking a plug in a tube, setting folks astride on the piston-rod, and then sucking—or as some exact people would have it, of blowing—them nobody knows where; except—as one day happened to a member of the Croydon family—when they sent the passengers on a flying visit through the wall into the midst of clerks, superintendents, secretaries, and directors; the engineer—quite accidentally—being *out of the way.* It appeared, upon after investigation, that the passengers' tickets had not been taken; and as the plan of locomotion was so exceedingly self-acting, it had adopted this signal mode of informing the superiors of the gross neglect of the understrappers; and in order to allow of this method of ready and direct communication, the offices had been very appropriately located *across* the end of the rails.

Fig. I.



I fear your valuable space will have been already heavily taxed by these lengthy remarks about the South Devon Railway; and though I have done with it for the present, yet I would trespass on your kindness for a few lines, to declare the exception of Devonshire, its beauties, mundane and feminine, from the carping hypercriticism of a chance wanderer like myself. The fertility of the gently undulated soil, so productive as rather to resemble a series of gardens than farms; the beauty of the wide-spreading foliage; the picturesque appearance of the bad farming, through many small freehold-signifying hedgerows; the brilliancy of the colours in the flowers; the presence of such greenhouse plants as fuschias, myrtles, geraniums, and a host of others, all blooming freely in the open air, and abounding in every cottage garden; the luxuriant vines ripening their fruit around the rustic porch, and under the broad projecting eaves of the homely thatch,—all present such varied, tranquil, and truly characteristic scenes of English life, as cannot fail to please the most fastidious, and are, by contrast, doubly pleasing to a northern eye. Of the male inhabitants, lords of the soil, I must ask permission to say nothing. Men are but men all the world over; but, with all due deference to the superior taste of my far *fairer* neighbours, I think—though I should not like to say I am sure—that there are a great many comely rosy faces, smiling lips, and bright dark eyes in Devonshire; indeed, it is said—though I only give it on report—that this county is more highly favoured in this respect than any other of its brethren; but certainly there are a great many ruddy cheeks *and* apples, and they—of course the apples—are particularly to be commended.

I entered Cornwall by means of Rendel's "Steam Bridge," which plies between Devonport and Torpoint. The "bridge," as it is termed, consists of two flat-bottomed boats, ranged side by side, about 10 feet apart, each boat being about 50 feet long, and 15 feet wide. Across the space between the boats is a frame-work of timber, supporting a small steam-engine with its boiler,—the fresh-water tanks being the "holds" of the boats,—and a cabin for passengers. Two chains of the common-link pattern, and made out of $\frac{7}{8}$ round iron, are stretched from shore to shore, and so far asunder as will just allow of their passing between the boats. Each chain goes round a drum, one on each side of the engine, which, by its alternate direct and reversed action, pulls the "bridge" to and fro; the "slack" of the chain lying at the bottom of the harbour, and in no way interfering with the passage of vessels. Hinged stages, raised and lowered by a windlass, are attached to each end of the "bridge," and are lowered on the shore as soon as the vessel has been pulled up to the shelving landing-place; carriages can be driven on and off the decks with nearly the same ease as in traversing an ordinary bridge, whilst the horses are saved the labour of draught for the three quarters of a mile which the machine travels, and can rest during the seven minutes occupied by the voyage. The tolls are not heavier than those taken at many substantial structures, being one penny for each foot passenger, and a proportionally higher rate for cattle and carriages. There is a double passage every half hour, commencing during the six summer months at six o'clock in the morning, and blowing off the steam at nine at night; during winter, they commence half an hour later, and leave off half an hour earlier. Two boats and sets of chains are provided, one set being in use while the other is laid by for repairs. I believe the scheme has been in successful activity for fifteen years. There is another of the same kind plying across a branch of Portsmouth harbour; but I am not aware of any other instance of their application, though probably they may be tolerably well known and appreciated for suitable situations.

The Eddystone Lighthouse, and the equally well-known Plymouth Breakwater, I merely mention for the purpose of fixing the locality; their description by such a will-o'-th'-wisp traveller would be a complete desecration of their hard-earned and well-merited celebrity.

From Plymouth to Falmouth is a natural and easy transition; and as your Journal is devoted to science, and science is in its happiest mood when turning nature's kindly gifts to man's advantage, grant me a few lines to pay my tribute for the glorious gift of nature to a seafaring population, as exemplified in Falmouth harbour. I do not consider myself particularly deficient in a general knowledge of the topography of the most remarkable places of our "island home." I had some notion that Falmouth possessed a good, indeed a *very* good harbour,—and the maps to which I referred confirmed the idea,—but my preconception of its importance fell immensely short of the grandeur of the reality. I find it difficult to express my admiration in adequate language; it is mere matter of fact to say, that it is the most excellent, thoroughly practical, and completely convenient natural harbour in the British isles. It owes as little to man as it well can do: capable of sheltering all our fleet, with room to spare, to be measured by square miles instead of acres; in fact, a sea of harbour within harbour, having salt water to float the largest ships, and two fresh water rivers for their use: it lies unimproved and half forgotten, and so neglected that nature's invitation to accept a shelter from the storm, or a safe port at the very beginning of the dangers and troubles of both channel passages, might be taken by her headstrong children as only a syren's song, to entice but to destroy.

Let those who have not had the opportunity of seeing its advantages examine its extent, situation, and sheltering peculiarities, by the aid of an Ordnance map,—I have found no other that did it justice,—and they will then see an additional cause for my displeasure with the mismanagement on the South Devon Railway, which is *en route* towards it, and should, I hope will, be the means of bringing its enormous capabilities into full and active exercise. The neglect of such an opportunity is indeed wonderful, more especially in these days of enterprise and action; but it may be in some measure owing to the peculiar character of the Cornish men, who, to the neglect of more solid but less glittering pursuits, are nearly all and entirely "mining adventurers;" and this recalls me to the more immediate subject of my letter,—the curiosities of art, rather than those of nature.

If only for the sake of contrast,—the big with the little,—the sublime with the ridiculous,—allow me to say, like a penny showman, "the next thing that I shall have the honour to present to your notice will be the Cornish shovel and wheelbarrow, and here they are." Figs. 2 and 3: Shovel, with a six foot handle, most conveniently designed for labourers who wear stays, in order to prevent their breaking the "busks" by bending their backs. Wheelbarrow, rather over than under ten feet long, measuring, in the approved fashion, "from the end of his nose to the tip of his tail." A natural historian would certainly be puzzled to give it a standing in any class, seeing it literally has not a leg to stand upon; indeed, so strange, at first sight, did the long narrow box appear to me, that, in an off-hand disrespectful manner, I pronounced it to be a queer kind of moveable pig-trough. Shade of the unknown patron saint of primitive wheelbarrows! an erring mortal invokes thy aid to open the eyes of all future travellers to the extended beauties of thy elongated trundling box! The spades are of the "shield" or "heart" shape, and when in use, with their long handles, beautifully illustrate the favourite lesson of one of my mathematical schoolmasters, who frequently informed us sucking mechanicians, "that the spade is often used as a lever of the third order, space at the expense of power," and this, in lifting heavy ores and stones.

Fig. 2.

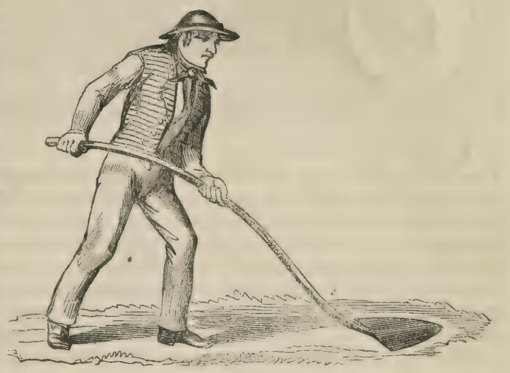
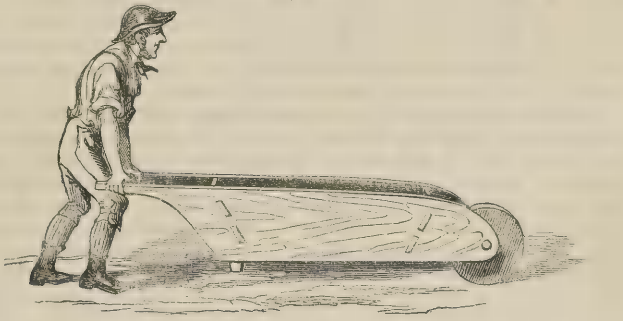
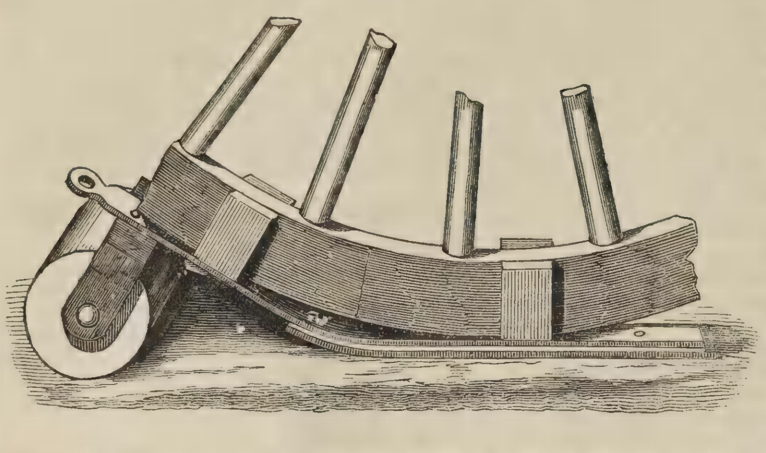


Fig. 3.



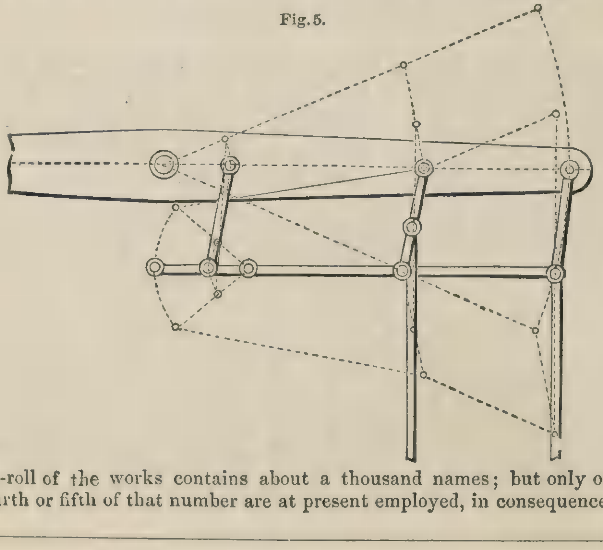
On the other hand, the common "drags" or "skids" excited my admiration. Cornwall cannot be called mountainous, but it certainly is a very hilly county; and as all the rocks are granite, or very hard stone, stone is ubiquitous, and appears in unexpected positions, performing functions ordinarily discharged elsewhere by wood or iron. Quarries, as well as mines, abound in all directions, and all the country one-horse carts are made to suit a load of stones, or a stray load of ore or metal, as well as the agricultural "yield" of roots and grain. These useful little carts are lightly built, and though capable of several improvements in some of their mechanical details, are, upon the whole, very sensibly constructed vehicles, and well suited to the locality; they have their strength just where it is required, and give as little dead weight as possible.

Fig. 4.



From the up and down course of the roads, the drags are in constant requisition, and must be made of more than common strength, in order to resist the constant tear and wear. Fig. 4 will give a general idea of their action and construction, the dotted lines indicating the position of the cart-wheel when "locked" in the "skid.' It is merely the common "shoe skid," with the front or "toe" considerably lengthened, and raised up sufficiently to allow of a roller of about nine inches diameter being attached to it, this roller constituting the chief peculiarity. By this addition the usual drag chain is superseded, and the danger of its failing during a dangerous descent is completely removed. I can only add, that the apparatus appeared to answer remarkably well, though it is probably adapted only for slow travelling. A local peculiarity in the mode of using these drags is noticeable when there happens to be a long line of carting from one spot to another, as, for instance, from a quarry to some building in course of erection. The drags, when out of use, are then left at the side of the road, instead of being carried along with each cart. As the loaded cart descends it uses the drag, and leaves it at the foot of the hill; the first empty cart that returns carries it to the top, where it is left for the use of the next loaded cart that is to make the descent. Of course, this is applicable only on some occasions, but was in full operation in several quarries that I visited.

Fig. 5.



Ill health unfortunately prevented my seeing more of Cornish mining than the mere surface operations and machinery, and I saw so little of even these, that I cannot venture to intrude my crude notes upon your attention; but, as a bit of an engineer, of course I could not leave Cornwall without going over one of their large engine factories. I was fortunately able to inspect that of Messrs. Harvey and Co., at Hayle, near St. Ives, an establishment where they not only talk of cylinders 144 inches diameter, but do actually make and complete them. When in full activity, the muster-roll of the works contains about a thousand names; but only one-fourth or fifth of that number are at present employed, in consequence of the great depression of trade; much of the machinery was therefore idle, and there was not half noise enough to render the sound musical to a tradesman's ears. I cannot say, after the London, Liverpool, Manchester, and Glasgow foundries that I have seen, that the "tools" and general arrangements at Messrs. Harvey's struck me as being particularly first-rate. I was disappointed in the large cylinder-boring apparatus. Perhaps I had allowed my imagination too wide a range. The machinery is certainly on a very large scale; but it is very much the same as looking at the now old-fashioned horizontal boring-bars and poppet-heads through a magnifying glass. Amongst the smaller tools were some of Collins and Whitworth's planing and shaping machines, Nasmyth's lever-planing and nut-shaping machines, and one of his large steam hammers. A decidedly neat modification of the parallelogram-parallel motion is adopted in the engine that drives these tools. As it may possibly be as novel to some of your readers as it was to me, I have annexed a sketch of it, fig. 5. It will be readily recognised as an inversion and very ingenious application of one of the ordinary marine motions. It does away with the necessity of spring beams, or their unsightly substitutes, for furnishing a fixed centre of action to the ordinary radius rods, as they are attached to the centre main standard, and economises as well as improves the framing of small stationary beam-engines. From Hayle I steamed to Bristol—celebrated and experienced for dear inns,—and thence by rail, through London, home; and thus terminated my visit to the Western Counties. The space occupied by this rambling letter will, I trust, be turned to good account, by tempting some one to occupy a fortnight in a pleasant ramble from the northern to the southern regions. Either by rail or sea the means of access are numerous, and locally convenient. Rail requires the longest purse and the most time. The railway route scarcely needs one word of remark; but perhaps the routes and fares of the steam-vessels may be acceptable. I will suppose the traveller to be like the German handicraftsman, in search of information, and willing to rough it on his way, and therefore not unprepared for a deck passage; this from Glasgow to Liverpool is 5s., with nearly his own choice of a day. From Liverpool to Bristol there is a steamer—the *Troubadour*, from Clarence Dock—every Saturday, deck 5s. also. From Bristol to Hayle there is a boat every Monday, Tuesday, and Friday, deck fare 3s. 6d. From Hayle, a twelve mile sixpenny ride on the West Cornwall Railway will take him to Redruth, the very centre of all the most celebrated and extensive mines. He may there see pumping and winding engines; crushers, stampers, and washers; bell cranks and L legs; swing beams and rocking rods; cup and balance valves; eccentrics, cams, and tappets; equilibrium, expansion, registering, controlling, counting, and reversing apparatus, in endless variety, to his heart's content. And if he be not quite *au fait* at such matters, he may make up his mind to be completely bewildered by the first sight of some of the valve motions. Many are like, yet unlike, magnified clockwork; the crooked levers appearing to be troubled with an uneasy mind, and constantly renewing a debate amongst themselves as to which way they are to go, and yet always making up their mind at the right minute, doing their work in a business-like manner, and then returning to their uncomfortable deliberations.

Last, not least, let him take heed of their great economy of fuel, and extreme jealousy of the escape of waste heat; and his spare time can be devoted to the examination of the really ingenious and often amusing modes of transmitting power to a distance.

When the surface is exhausted, our craftsman can dive below; and there leaving him in pursuit of new wonders, permit me to make my best bow to yourself and readers, hoping, in the Cornish style, that—saving always the Teignmouth washing and Bristol inn charges—some "adventurers" may be found willing to work the vein I have endeavoured to open out; and, with every assurance of a profitable "yield" from their adventure, I venture to subscribe myself,

October, 1849. D.

P.S.—Since writing the preceding, I have just met with the following public proof, and premonitory punishment of the "slow coaching" of the South Devon Railway Company. Pray be so kind as to give your readers the benefit of perusing such a curious piece of intelligence. When it is borne in mind that the total length of this celebrated railway is 57¾ miles, *including* all roadside junctions, the full value of the mismanagement will become apparent, and it will be seen that my report is no more than the truth:—

"*Liability of Railway Companies.*—A case involving a point of great importance to business persons was decided on the 8th September, at the Exeter District County Court, before John Tyrrell, Esq. The action was brought by John Hull Tyrrell, a solicitor, at Exeter, against the South Devon Railway Company, to recover compensation for his loss of time in being detained at the railway station at Starcross, where, on the 3d of July last, he had paid his fare to be conveyed to Exeter. The time-table stated that a train would leave Plymouth at 55 minutes past 6, arrive at Starcross at 12 minutes past 9, and reach Exeter at 27 minutes past 9; but it did not arrive at the Starcross station until an hour after its time, and did not reach Exeter until 25 minutes past 10. Some of Mr. Tyrrell's clients, with whom he had appointments at his office, were kept waiting, and his business was delayed. The learned judge said his impression was, that if a train were 5 minutes behind, or if it were obstructed by a drift of snow, or a high wind, or was by any unavoidable accident prevented from fulfilling its time, that would be a good answer to an action; but whether the company were unreasonably behind their time or not, would be in all cases a question for a jury. If the company thought they might suffer their servants to be as indolent as they pleased, and to be one hour behind time, they might as well claim a right to be 3 hours behind, or not to come at all, after having led the public to wait for them at a particular hour and place. The jury found that there was a contract to carry passengers at a certain time, and that there was unreasonable delay, and they awarded 10s. as compensation."—*Weekly Chronicle.*

THE BRITISH ASSOCIATION AND ITS BIRMINGHAM EXPOSITION.

Our first rough notes of this very notable assembly* concluded somewhat abruptly, just upon the threshold of the Exposition, which, we are afraid, we must again leave for a short time, to permit of a sketch of the later proceedings of the Association itself.

In the afternoon of Monday, the third business day of the meeting, the General Committee assembled for the purpose of deciding upon the acceptance of one of the many invitations for next year, when, as before stated, Edinburgh was finally settled upon, with Sir David Brewster as president.

In the evening, Professor Willis gave a running dissertation "On the Application of Science to Railways." As the author of the "Principles of Mechanism" alone, we anticipated a valuable discourse on this occasion, and our notes upon it, in the present pages, show that we were not disappointed. It may be urged, that the vast extent of matter comprised within the title chosen by the lecturer, was immensely disproportioned to the limits of an evening; but the one single branch which he undertook, was too well treated to leave room for objections on this ground. The subject was the trials and results of the Government Commission of Inquiry into the application of iron to railways, arising more immediately from the unfortunate failure of the cast-iron Dee bridge. An excellent illustration of the experiments was afforded by a model railway, with an inclined plane, to obtain the required velocity of the passing waggon. The descriptive matter was entirely oral, and the peculiar action of the lecturer, with his half-soliloquising, half-addressing style of explanation, gave interest to many otherwise dry details.

On Tuesday, Mr. Nasmyth's paper, "On a new Oil Test," opened the proceedings of the mechanical section. In contriving this test, the inventor has taken the greater or less liability to viscidity of the oil when in contact with the atmosphere, as the true point to be considered in deciding on its economic lubricating value; and with this view he prepared a very simple arrangement for measuring the relation existing on this head between the various qualities of the oil. This was nothing more than a slightly inclined plane, variable to any angle, and having a series of grooves running down it from top to bottom. The different oils are separately placed in given equal quantities at the top of each of the row of grooves, and left to find their way to the bottom. Mr. Roberts very correctly remarked, that no test could be satisfactory, unless the necessary conditions under which the oil worked in practice were observed; some oils might preserve their fluidity, but this was no proof of their value as lubricators. Comparing this test with that of M'Naught, we at once see the superiority of the latter, for in it the actual frictional action of the working machine is going on; and, where *temperature* is observed, very accurate results are to be obtained from it. On the other hand, the simple question of viscidity touches only one point; and the most viscous oil, under the atmospheric influence alone, may not by any means possess the worst anti-frictional properties, when undergoing a rubbing action between metallic surfaces. The second paper was on the very clever arrangement of a "Copying Electric Telegraph," of Mr. Bakewell, fully described in our September part. The peculiarly correct action of the transmitting and receiving instruments excited much attention amongst the members. "Hosmer's self-acting House-Cistern, and its operation as a sanatory machine," brought forward by Mr. Wood, who exhibited a model, formed the subject of the succeeding paper. In the few ensuing remarks, Mr. W. Snow Harris urged the necessity of beginning the system of drainage at each house, as, without cleaning the source of impurity, any main sewerage would be of little avail. Mr. Roberts followed with a valuable paper "On the correct sizing of Toothed Wheels and Pinions." This dissertation bore reference chiefly to the wheels used in clockwork: its particulars will be found in another page. "A Plan for Ventilating Coal Mines" was then introduced by Mr. Nicholson. It embraced the placing the fire employed for the rarefaction of the air at the top, instead of the bottom of the shaft. The several suggestions offered by the author have been long ago tried, and do not now require our condemnation. Mr. Eaton Hodgkinson concluded the transactions of the morning by an address "On the strength and elasticity of Stone and Timber," in which some curious and important observations on the defective elasticity of cast-iron, as producing a certain "set," by minimum strains or weights, were brought forward.

An attraction for the afternoon was formed by a set of experiments at the Reservoir, by Mr. Carte showing the application of rockets as a means of saving life in cases of shipwreck. Mr. Carte is the inventor of the annular life-buoys, now so universal amongst steam and sailing vessels; and from his experience of the necessities of the casualties affecting seafaring men, we had expected to find some novel practicabilities amongst his plans. In this expectation we were disappointed, for the trials involved nothing more than the shooting a rocket, with an attached line, to the point where assistance is required from the land. The rocket is placed in a grooved frame, elevated on legs, and arranged so as to be easily elevated or depressed, to suit the range. From this, we saw several rockets carry light lines across the sheet of water, probably a distance of 200 yards. Afterwards, the supporting power of the annular life-buoy was exhibited, by passing a man across the reservoir in it. The ring was placed beneath his arms, and one of the rocket lines, previously fired across, being attached to it, he was drawn across with great facility. Now there is nothing new in all this. Captain Manby, several years ago, introduced the same principle of communication, employing a mortar to fire an anchor out to the wreck. It is an easy matter to send a line across a mill-pond; but what would it be when carrying a line of the power required out from shore, right in the teeth of a gale?

Another agreeable *conversazione* took place in the evening, in the Town Hall. This, as one of the pleasantest accessaries of the occasion, was enjoyed to the utmost by the numerous attending parties. Astronomers, geologists, botanists, chemists, statisticians, and, lastly,—engineers, with a sparkling array of ladies,—here mingled together, in promenade and conversation; whilst the music of the majestic organ, and the discussion on art-productions, ornamental and useful—from the electroplate of Elkington and the papier-maché of Jennens & Bettridge, to the liberalities below stairs—filled up the passing hour. Amongst the illustrative mechanism and processes in the rooms, were Mr. Bakewell's telegraph, and anastatic and lithographic printing. At the table of the latter were produced fac-simile impressions of the signatures of most of the celebrities of the Association, who were actively canvassed for their autographs upon the transfer paper, for the lithographic stone.

On Wednesday, the General Committee met to sanction the grants which had passed the Recommendation Committee; and in the afternoon, the accustomed concluding ceremonial meeting was held in the Town Hall. Thus ended the nineteenth meeting of the British Association.

We may now pursue our Notes upon the Exposition—too long kept back. From such a vast collection of good things in art and mechanism, it would be a work of much time and consideration to particularise even a small portion, and we must simply glance at the collection as a whole. After Messrs. Winfield's extensive collection of sheet-metal productions, comes a vast array of iron-work, stoves and various domestic contrivances, by Messrs. Mapplebeck & Lowe, and Mr. H. Room. Mr. Messenger's celebrated works find a resting-place opposite the entrance-door, and in close contact with him comes Mr. Lane, whose papier-maché works deservedly attract attention. Further on are the brilliant glass productions of Mr. Rice Harris; Mr. Copeland's statuary and porcelain; Messrs. Bacchus' glass; Jennens & Bettridge's papier-maché; and, finally, at the end of the room, is an immense space covered with the manufactures of Messrs. Hardman, from designs by Mr. Pugin the architect. This gorgeous display embodies a collection of all the various furnitures which are to be found in the Catholic Church—such a collection, indeed, as was never before seen in this country. Again, turning towards the entrance of the room, we approach Mr. Walton's japan works; Messrs. Minton's porcelain; Cotterill's locks; Messrs. Richardson's glass; the iron-castings of the Colebrookdale Co.; and Mr. Potts' bronzes; ending with the wood-carving of Mr. Jordan. The main central stalls are those of Messrs. Collis, whose works in precious metals make so fine an appearance; Elkington, Copeland, and the glass of Messrs. Osler. M'Callum & Hodson are also here as powerful rivals to Messrs. Jennens & Bettridge in papier-maché; and in the same corner is a fine collection of carpets, tapestry, and bronzes, from M. Sallandrouze de Lamornaix—fulfilling an important mission here, as examples of French manufacture for comparison with our own. In another quarter, near the corridor, is a case of ingeniously-contrived door-springs, invented by Mr. Cotterill, and contributed by Messrs. Hudson & Hipkins;

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and further on is a set of the 806 parts which go to make up a watch, exhibiting it in all its various stages, from the original metallic blanks, up to the finished chronometer,—these are from the celebrated house of Rotherham of Coventry.

Illustrative of the wire manufacture, an interesting example is exhibited by Messrs. Sharpe, Brown, & Co., of Halifax and Birmingham. It is a short and thick bar of wrought-iron, as in the rough state, previous to going through the primary rolls, one end being drawn down to the state of the finest wire used for cards in textile manufactures. The contrast of the two ends is very striking, affording the best possible illustration of the process of reduction. The corridor connecting the building with Bingley House, introduces us to the mechanical division of the collection. This portion is principally devoted to agricultural implements, interspersed with the various articles produced in Birmingham and its neighbourhood. The peculiar process of "raising" copper and brass from the flat sheet, is illustrated by a series of brass kettles and pans, from the Battery and Metal Co., Digbeth. Comparing a flat sheet with these hollow works, we begin to comprehend the extreme ductility of the metal which admits of such a change of figure, merely by continued hammering.

Mr. Roberts of Manchester here displays a goodly number of mechanical ingenuities, amongst which are Baranowski's reckoning machines, and several modifications of the mechanical principle brought forward by him at the last meeting of the British Association, and illustrated at page 150 of our first volume. In one of these, two wheels of equal diameter revolve on one shaft, at different speeds, in an opposite direction to that of the shaft: whilst the shaft makes 22 revolutions, the first wheel revolves once, and the second one revolves once whilst the shaft turns 33 times. The system is shown in practical application in the construction of an engine-counter, for recording the strokes in any given period. It is very simply constructed, being composed of a series of discs, placed close together, all on one shaft, and numbered on their peripheries from 1 to 10. As the shaft turns, each disc turns in the same direction—the first of the series having a movement of $\frac{1}{10}$th of a revolution, the second $\frac{1}{100}$th, for each turn of the shaft. The same gentleman exhibits a well-arranged "normal drill," intended for piercing the pivot holes in the frame-plates of chronometers and watches.

Messrs. Rennie & Co. contribute several models of paddle-wheels and propellers, comparing the "trapezium" floats invented by Mr. Rennie, with the rectangular ones of the ordinary wheel. Another model exhibits a mode of propulsion by the reaction of elastic blades, placed in pyramidal recesses on each side of the stern—a contrivance which some years ago occupied our own attention. A variety of specimens of the productions of Messrs. Prosser & Hadley's sawing machinery, for works of the "fret" class, are worth attention, the accuracy and speed of movement being quite extraordinary. At the termination of the corridor, in one of the lower rooms of Bingley House, is a collection of machines manufactured by Mr. Henry Knight. Amongst these, we may particularise the several arrangements for fly and other presses, wherein several ingenious modifications are introduced. A number-printing machine, intended for paging books, numbering tickets, and similar purposes, is a very beautiful invention. By simply turning two adjusting pins, the impressions are capable of alteration from regular consecutive numbers to alternates or thirds. A glass tube water-guage, with brass guard to defend the glass, is worth copying. As a curiosity, Mr. Knight exhibits a clock with a conical pendulum, without any escapement. The works, of the usual class, are in a neat rectangular case, the top of which is surmounted by a bell-glass covering the pendulum and its impelling action. The last wheel of the train, in the case below, is a worm-wheel, and this gears into a worm upon a short vertical shaft, projecting up through the top of the case, into the space enclosed by the glass shade. The projecting portion of the shaft carries a short cross-shaft, one end of which presses against the lower end of the pendulum rod, which is nothing more than a single straight wire, having a spherical pendulum weight on its lower end. The cross-shaft receives a direct and continuous impulsion from the works, through the worm and wheel previously mentioned; and in its revolution, one end carries round the pendulum, which is suspended from a centre directly over the shaft, and thus the chronometric movement is kept up continuously. In contradistinction to the dead-beat non-recoil movement of modern practice, the impelling power is here continually in action. For a sick chamber such a clock might be judiciously employed, as it makes no noise; in other respects, it is simply a curiosity. In the same room stand the models of Davies' rotatory engine, with a full-sized example of his metallic packing. Both the working model and the sectional movement appear to command a full share of attention. Mr. Davies also exhibits an example of his ingenious gas-exhauster and blower. In its latter condition, this invention is shortly to receive a trial at the copper smelting-works of Messrs. Elkington in Wales.

One of the most attractive features of the collection, is a beautiful model of the Britannia tubular bridge, contributed by Mr. Fairbairn; as also, one of the tubular bridge over the Bure at Yarmouth.

We shall hereafter enter into the detail of some of the principal mechanical subjects which attracted our attention, with illustrations of some of the more important objects.

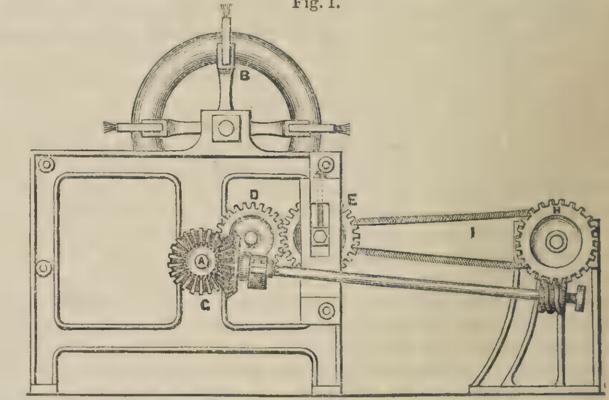
On first viewing the Exposition, we must confess that our anticipations as to the mechanical department were but faintly realized, but this arose from considering the collection as nearly connected with our own pursuits, whereas its aim and object has been to bring together the staple art-productions of the metal-working district in which it is placed. Putting aside the mechanical department as a mere adjunct, we are only echoing the opinions of all visitors, when we state that it has far—very far—exceeded the highest expectations that could have been formed of it. A few more of such collections, and art-manufacturers will, as a body, imbibe an emulative impulse of the highest value to them, not only as constructors, but as originators.

An auspicious beginning like this, will, at any rate, perpetuate the recollection of the Birmingham Exposition.

BURN'S ROLLER-GIN FOR CLEANING COTTON.

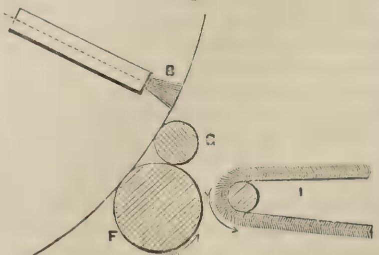
This gin is intended to remove the disadvantages now felt by the cotton manufacturer, in treating the crude, short-stapled production of the East Indies, which is quite unmanageable under Whitney's ingenious saw-gin, or by the existing roller-gin. At present, whilst an impracticable attempt is made to cleanse the material by manual labour, the Surat cotton arrives in this country in a miserably seedy state, quite unfit for most of the purposes of the manufacturer, and thus this class of cotton has suffered an undue depreciation in value. Mr. Robert Burn of Edinburgh, the inventor of the roller-gin now under treatment, proposes to remedy the evil of a slow and imperfect separation of the seed, by some modifications of the ordinary roller-gin, the details of which are illustrated in our engravings. Fig. 1 is a side elevation of the machine in working order, with the cover removed; fig. 2 is a detached sketch of the separating rollers, brush, and feed apparatus. A, Is the main shaft of the machine, having on one end a fast-and-loose driving-pulley, and a spur-wheel gearing with a pinion fast on the end of the shaft of the rotatory brush, B. The same wheel also drives a pinion fast on the shaft of a steel roller, C, the upper one of the pair between which the cotton is passed in the process of cleansing. The opposite end of this shaft carries a pinion working into a wheel, D, gearing with a similar wheel, E, on the shaft of the lower or wooden roller, F. The pair of bevil pinions, G, also driven from the main shaft, give motion by means of an inclined shaft, with a worm on its end, to the worm-wheel, H, on the outside roller, over which the endless feed-cloth, I, is passed, for the conveyance of the cotton to the rollers.

Fig. 1.



1-12th.

Fig. 2.



1-4th.

The feed-cloth is coveredwith card teeth, for the purpose, as the patentee remarks, of supplying the cotton with greater regularity, and at a less cost of hand-labour, than when a plain apron is used. As the crude cotton enters the pair of separating rollers, C F, the seeds are prevented from passing through with it, by the closeness of the set of the roller surfaces: the seeds consequently fall back between the wooden roller and the termination of the feed-cloth, whilst the fibres of the cotton, as they appear on the in or delivering side of the rollers, are brushed off by the action of the revolving brush, or "brush-fan," B, which has attached to it a heavy fly-wheel for the purpose of keeping it steady.

As the cleansed cotton is separated by this combined roller and brush action, the fibres are collected in a cover surrounding the brush, B, and are delivered by an opening on the opposite side of the machine. The bearings of the steel roller are fixed, whilst those of its wooden partner are adjustable.

We saw a machine of this class at work some time ago in the extensive cotton works of Messrs. Robert Thomson and Son, of this city, where it was some time under trial by Mr. Stephen, the manager of the establishment. The length of the separating rollers was only a foot, being much too short a surface for an efficient delivery of cleaned cotton. Probably the pressure upon them during the attempted passage of the seeds, arising from the close proximity of their surfaces, may act as a preventive against the use of longer rollers, owing to the tendency to spring. Whether or not this is the case, it is evident that the amount of work performed is by no means equal to what ought to be done by any machine, professedly an improvement upon the present system. To keep back the seeds, the rollers must be so closely set that the action must necessarily be slow; and if the greatest care is not observed in feeding, the thicker layers of cotton will choke the rollers. Whilst we credit Mr. Burn for producing a machine that will effectually cleanse the cotton, we are, nevertheless, of opinion, that the very means employed in arriving at that effectual action, are fatal to the economic speed of production so much desired.

DR. ROBINSON'S ADDRESS TO THE BRITISH ASSOCIATION.

NINETEENTH MEETING, BIRMINGHAM, Sept. 12, 1849.

[Concluded from page 153.]

I have left myself but little space to consider how far we have fulfilled the third of our objects,—"to obtain a greater degree of national attention to the objects of science." Most assuredly it was needful; for nowhere in the civilized world is less honour paid by a nation to science, though nowhere is national prosperity more connected with its progress, nowhere are heavier penalties paid for its neglect. I do not now refer to the remarkable fact, that in Britain only, men whose scientific fame fills all Europe were seldom thought worthy of any honorary distinction by their government. As it relates to themselves, this is of no importance; but it is of deep concern to the honour of this country. The true votary of science loves it for itself: in its possession he has a higher honour, a nobler decoration than man can give. *He* does not require to be bribed to follow it by titles or ribbons,—the baits for meaner spirits, the lure to lower achievements. But he knows that though *he* despises such gauds, those who bestow them hold them precious; and they serve him as a scale by which he finds that great men once placed a Herschel or a Brewster nearly on a level with a third-rate soldier, or the annual magistrate of some town that might be honoured with a royal visit. Nor do I refer to the miserable economy which permitted such men as Ivory and Dalton (to speak only of the dead) to waste, in the drudgery of earning a precarious subsistence, the years, the powers, the hopes which could have borne light into the remotest and darkest recesses of the realms of inquiry; though it does contrast painfully with the munificent provision which republican France and despotic Russia heap on such men when they can find them. Both these spring from the same root;—the gross ignorance in this province of the intellect which, up to the beginning of this Association, and long afterwards, prevailed in the land. The industrial classes of our countrymen were wont to rely in their pursuits on the unenlightened dexterity and empirical success which resulted from experience, and to scoff at the idea of learning anything useful from a mere theorist: those whom wealth and independence permitted to choose, seldom sought employment or pleasure in this unfashionable region,—their education, though the best then current, having given them very little cognizance of what it might contain. And to ascend still higher, even to the executive and legislative bodies, they "cared still less for science;" the tension of political life engrossed all their faculties: they disliked philosophers as meddlers, or despised them as dreamers. The head of a great military department once said that he *hated* scientific officers! Any one of his engineers might have told him that more money had been wasted and lives lost in that department, from sheer ignorance of science, than any one could think of without shame and sorrow. The question which I know to have been asked by another in "high places," though milder in expression, was not less scornful—"Of what use is science?" He who asked it ought to have known better. Whatever tends to raise man above low and sensual pursuits,—whatever to lead him from the partial and present to the general and the future,—whatever to exalt in his mind the dominion of order and the supremacy of truth,—that must be useful to the individual, useful to the nation. Even had he been incapable of rising above the gross measure of pecuniary value, he ought to have been able to give a mighty answer to his own inquiry. There is not a single element of our commercial prosperity in which the vivifying power of science might not be felt, in which the loss arising from want of that certainty of action which mere unenlightened practice can never attain, does not reach an amount which, if stated in figures, would astound the most thoughtless. For instance, the causes which in our great cities hasten the death and debase and embitter the life of so many, have at last been forced by chemists and physiologists on the notice of the public. Look at Dr. Smith's Report on the Air and Water of Towns, in this volume; and when we think that the victims of the deadly influences which are there revealed, are chiefly found among the people whose industry is the foundation of our greatness,—that every year cut off from the life of each of these is so much subtracted from national wealth,—even were all moral sense or religious feeling dead in us, we must confess that the knowledge which is capable of averting them "is of use." The ships that bear the treasures produced by this industry through the world are lost to a fearful amount,—nearly *three* daily. What are they worth,—ship, cargo, men?—and most of them perish from want of nautical science or from unscientific construction. How many men have been ruined by searching for minerals, when the merest smattering of geology would have dispelled their delusion! On the other hand, the agricultural produce of our islands might be doubled by a more perfect application of the principles of botany and chemistry. The manufacture of iron has been augmented sixfold by the use of the puddling furnace and the hot blast,—both gifts of theory. How gigantic a result is this, without reference to the increase in the thousand arts of which this immense supply of that most precious of metals is the exponent! The splendid machinery in which we excel the world, owes its present perfection to mechanicians who are conspicuous in *our* Sections, to impulses given by philosophers like Willis or Babbage. Nay, the steam-engine itself, your immortal townsman's great conquest,—that earthly Fate to which now seems to be committed the weaving of the world's destiny,—that itself was a pure induction of science;—and beyond *that* I need not go. But we live in better times; for no statesman now would be so imprudent as to ask such a question, even were there any so unfortunate as to think it,—which I trust there are not. And this change, we, the British Association, have in no small degree helped to produce. We have carried, far and wide through the land, the light which before beamed only from a few scattered points: if our meteor-like presence be short, it is also bright; and as the meteor is remembered when the stationary lamp is unheeded, so I trust that, of the tens of thousands who have felt our influence, few will forget the impression which it made on them, and fewer fail to feel that this impression ennobled and exalted their understanding. It is evident that science now has a far more powerful hold on public opinion than when we began our course. No other proof is needed of this than the fact, that many new branches of it are finding their way into the course of University instruction. Without referring to the recent changes in those of this island, I rejoice to say that in my own—that of Dublin—within the last year, Chemistry, Thermotics, Electro-Magnetism, and others, have been made a portion of the under-graduate course; while one of our own valued members has introduced into primary schools a manual of Zoology, of which the spirit is as good as the substance is attractive. But there is another evidence, not less satisfactory, in reference to this our third object, and I name it with pleasure,—the prompt and liberal attention which our government now pays to the requests of the Association. It is true that we have never applied to it except for matters of paramount importance and unquestionable usefulness; but in times past it would have been no easy matter to force a conviction of this on the guardians of the Treasury; and we may therefore feel assured, not only that they personally take an interest in what we bring before them, but also that the whole nation sympathizes with us;—for some of these concessions are of no ordinary magnitude. The completion of the ordnance survey of Scotland—the enlarging the scale of part, perhaps all, of that of England—and the adding lines of level to that of Ireland after it was apparently completed—are very formidable items in a budget. At our demands the Observatories, from which such splendid additions have been made to our knowledge of Magnetism and Meteorology, have been established far and wide throughout our dominions;—a precious gift, not only for itself, but for what it has produced. The example was followed, on their usual princely scale, at four stations by the East India Company (always, be it said, munificent patrons of science), and still more extensively by Russia—with what success must be fresh in the memory of those who were present at the Magnetic Congress. We obtained the Antarctic Expedition of Ross, so fertile in its geographic fruit—so invaluable for the wide extension which it gave to the domain of terrestrial magnetism. We procured the expenditure of large sums for the reduction of the Greenwich lunar observations, and for publishing the Catalogues of Lacaille and Lalande,—and much more which I need not recite. Yet, —and we well may reckon it a sign of progress,—not a single voice has been raised in opposition to these grants. It seems as if our country recognised in us its scientific representatives,—as if we were like the Saxon prototype of its great council: its Witena-Gemot—its assembly of the Wise.

And may we deserve that name; for let me remind you that science is not necessarily wisdom. To know, is not the sole nor even the highest office of the intellect; and it loses all its glory unless it act in furtherance of the great end of man's life. That end is, as both Reason and Revelation unite in telling us, to acquire the feelings and habits that will lead us to love and seek what is Good in all its forms, and guide us by following its traces to the First Great Cause of all, where only we find it pure and unclouded. If science be cultivated in congruity with this, it is the most precious possession we can have—the most divine endowment. But if it be perverted to minister to any wicked or ignoble purpose—if it even be permitted to take too absolute a hold of the mind, or overshadow that which should be paramount over all, the sense of duty, the perception of right—if it does not increase in us the consciousness of an Almighty and All-beneficent Presence,—it lowers instead of raising us in the great scale of existence. This, however, it can never do but by our fault. All its tendencies are heavenward;—every new fact which it reveals is a ray from the origin of Light, which leads us to its source. If any think otherwise, their knowledge is imperfect, or their understanding warped or darkened by their passions. The Book of Nature is, like that of Revelation, written by God, and therefore cannot contradict; both we cannot read through all their extent, and therefore should neither wonder nor be alarmed if at times we miss the pages which reconcile any seeming inconsistence. In both, too, we may fail to interpret rightly that which is recorded; but be assured, if we search them in quest of truth alone, each will bear witness to the other,—and physical knowledge, instead of being hostile to religion, will be found its most powerful ally, its most useful servant. Many, I know, think otherwise; and because attempts have occasionally been made to draw from Astronomy, from Geology, from the modes of the growth and formation of animals and plants, arguments against the divine origin of the Sacred Scripture, or even to substitute, for the creative will of an intelligent First Cause, the blind and casual evolution of some agency of a material system, they would reject their study as fraught with danger. In this I must express my deep conviction, that they do injury to that very cause which they think they are serving.

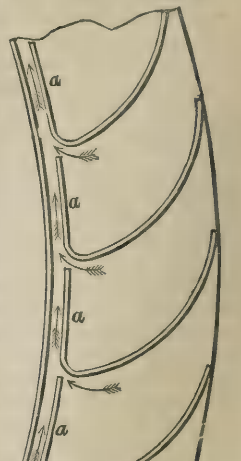
Time will not let me touch further on the cavils and errors in question; and besides, they have been often fully answered. I will only say, that I am here surrounded by many matchless in the sciences which are supposed so dangerous, and not less conspicuous for truth and piety. If *they* find no discord between faith and knowledge, why should you or any suppose it to exist? On the contrary, they cannot be well separated. We must know that God is, before we can confess them;—we must know that He is wise and powerful, before we can trust in Him—that He is good, before we can love Him. All these attributes, the study of His works had made known before He gave that more perfect knowledge of himself with which we are blessed. Among the Semitic tribes, his names betoken exalted nature and resistless power; among the Hellenic races, they denote his wisdom; but that which we inherit from our Northern ancestors, denotes his goodness. All these the more perfect researches of modern science bring out in ever-increasing splendour; and I cannot conceive anything that more effectually brings home to the mind the absolute omnipresence of the Deity, than high physical knowledge. I fear I have too long trespassed on your patience, yet let me point out to you a few examples. What can fill us with an overwhelming sense of His infinite wisdom like the telescope? As you sound with it the fathomless abyss of stars, till all measure of distances seems to fail, and imagination alone guages the distance; yet even there, as here, is the same divine harmony of forces, the same perfect conservation of systems, which the being able to trace in the pages of Newton or Laplace makes us feel as if we were more than men. If it is such a triumph of intellect to *trace* this law of the universe, how transcendent must that Greatest over all be, in which it, and many like it, have their existence! That instrument tells us that our globe and we, are but a speck, the existence of which cannot be perceived beyond our system. Can we then hope that in this immensity of worlds we shall not be overlooked? The microscope will answer. If the telescope lead to one verge of infinity, *it* brings us to the other; and shows us that, down in the very twilight of visibility, the living points which it discloses, are fashioned with the most finished perfection,—that the most marvellous contrivances minister to their preservation and their enjoyment,—that as nothing is too vast for the Creator's control, so nothing is too minute or trifling for His care. At every turn the philosopher meets facts which show that man's Creator is also his Father,—things which seem to contain a special provision for his use and his happiness:—but I will take only two, from their special relation to this very district. Is it possible to consider the properties which distinguish iron from other metals, without a conviction that those qualities were given to it that it might be useful to man, whatever other purposes might be answered by them? That it should be ductile and plastic while influenced by heat, capable of being welded, and yet, by a slight chemical change, capable of adamantine hardness,—and that the metal which alone possesses properties so precious should be the most abundant of all,—must seem, as it is, a miracle of bounty. And not less marvellous is the prescient kindness which stored up in your coal-fields the exuberant vegetation of the ancient world, under circumstances which preserved this precious magazine of wealth and power, not merely till He had placed on earth beings who would use it, but even to a late period of *their* existence, lest the element that was to develop to the utmost their civilization and energy might be wasted or abused. But I must conclude with this summary of all which I would wish to impress on your minds—that the more we know His works, the nearer we are to Him. Such knowledge pleases Him: it is bright and holy; it is our purest happiness here, and will assuredly follow us into another life if rightly sought in this. May He guide us in its pursuit; and, in particular, may this meeting, which I have attempted to open in His name, be successful and prosperous,—so that, in future years, they who follow me in this high office may refer to it as one to be remembered with unmixed gratification.

ON WATER-WHEELS WITH VENTILATED BUCKETS.

By William Fairbairn, M. Inst. C.E.*

Breast-Wheels, with close Soles, and Ventilated Buckets.

The preceding statements have been principally confined to the form of bucket, and description of water-wheel, adapted for low falls. It will now be necessary to describe the best form of breast-wheels for high falls, or those best calculated for attaining a maximum effect on falls varying from one-half to three-fourths of the diameter of the wheel. This is a description of water-wheel in common use, and is generally adopted for falls which do not exceed eighteen feet in height, and, in most cases, is preferable to the overshot-wheel. It possesses many advantages over the undershot-wheel, and its near approximation to the duty, or labouring force, of wheels of that description, renders it applicable, in many situations, especially where the fall does not exceed eighteen or twenty feet, and where the wheel is exposed to the obstructions of backwater. In the latter case, wheels of larger diameter are best adapted, and, provided sufficient capacity is left in the buckets, such wheels may be forced through the backwater without diminution of speed. Every wheel of this kind should have capacity in the buckets to receive a sufficient quantity of water, to force the wheel, at full speed, through a depth of five or six feet of backwater; and if these provisions are made, a steady uniform speed, under every circumstance of freshes and flood-waters, may be attained.



A water-wheel of this kind, of one hundred horse power, was constructed for T. Ainsworth, Esq. of Cleator, near Whitehaven, about four years back, for driving a flax-mill; it is twenty feet in diameter, twenty-two feet wide inside the bucket, and twenty-two inches deep on the shroud. It has a close riveted sole, composed of No. 10 wire-guage iron-plate, and the buckets are ventilated from one to the other, as shown on the large scale in the woodcut. The fall is seventeen feet, and the water is discharged upon the wheel by a circular shuttle, which is raised and lowered by a governor, as circumstances require. By this arrangement, the whole height of the fall is rendered available, and the water in dry seasons may be drawn down from three to four feet, in order to afford time for the dam to fill, during the periods of rest, either during the night, or at meal-times.

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* Concluded from page 146, Sept. 1.

In this wheel, the power is taken from each side by two pinions working into two internal segments, and these again give motion to shafts and wheels which communicate with the machinery of two different mills at some distance from each other.

The position of the pinion, or the point where it "gears" into the segments, is of some importance in every water-wheel, but more particularly in those constructed on the suspension principle, which, upon inspection, will be found but indifferently prepared to resist a torsive strain, when the power is taken from the opposite side of the loaded arc of the wheel. Water-wheels of this construction, with malleable iron rods only two inches in diameter for their support, could not resist the strain, but would twist round upon the axle as a fixed centre of motion.

It therefore becomes necessary, on every occasion, to take the power from the loaded side of the wheel, and as near the circumference as possible, in order to throw the weight of the water upon the resistance of the pinion, and that such resistance shall be at the point of the greatest velocity.

In the old water-wheels, where the power was generally taken from the axle, the whole of the force first passed through the arms to the axle, and afterwards by a pit-wheel, or some other multiplier of speed, to the machinery in the mill. Now, in the improved wheels this is not the case, as the arms, braces, and axle have only to sustain the weight of the wheel, and to keep it in shape, and by the power being taken from the circumference, considerable complexity of the transmission of the power is avoided; a great saving is also effected, when the speed required is greater than that of the wheel.

It has already been shown that this description of wheel has a close sole, and on reference to the figure it will be found that the tail-ends of the buckets, *a, a, a*, are turned up at a distance of two inches from the back of the sole-plate, and, running parallel with that part, terminate within about two inches from the bend of the upper bucket. The object of this construction is obvious, as the water, in passing through the openings between the buckets, drives the air before it in the direction of the arrows at *a, a, a,* into the bucket above, and so on in succession, till each bucket is filled as it passes the aperture of the cistern, from which the water flows upon the wheel.

Irrespective of the advantages of clearing the buckets of air, additional benefit is obtained by the facility with which the water is discharged, and the air again admitted at the bottom of the fall, during the period of the emptying of the bucket into the tail-race.

This is strikingly illustrated where the wheels labour in backwater, as the ventilated buckets rise freely above the surface, and the communication being open from one to the other, the action is rendered perfectly free at almost any depth to which the wheel may be immersed.

In breast-wheels constructed for falls of twenty-five feet or upwards, the stone breast is not required, as the buckets are formed with narrow openings, and the lip being extended nearer to the back of the following bucket, the water is retained much longer upon the wheel. Under these circumstances a stone breast is of little or no value, when attached to a wheel with close buckets, on a high fall.

The construction of the breast-wheels, as above described, is almost exactly similar to that for the lower falls; malleable iron arms and braces being common to both, as also the axle, shroud, and segments. These, when duly proportioned and properly fitted to each other, form one of the strongest, and probably the most permanent, structures that can be attained in works of this description.

Common Breast-wheel (not ventilated), as constructed by Messrs. Fairbairn and Lillie, between the years 1825 *and* 1827.

Four wheels of this description were constructed for Messrs. James Finlay and Co., for a fall of thirty-two feet, at Deanston, in Perthshire, and two others, for the same firm, at the Catrine Works, in Ayrshire, on a fall of forty-eight feet, upon the plan of the overshot or breast-wheel, taking the water at an elevation nearly equal to that of its height. Taking into consideration the height of the fall, the Catrine water-wheels, both as regards their power and the solidity of their construction, are, even at the present day, probably among the best and most effective structures of their kind in existence. They have now been at work upwards of twenty years, during which time they have required no repairs, and they remain nearly as perfect as when they were erected.

It was originally intended to have erected four of these wheels at the Catrine Works, but only two have been constructed; preparations were, however, made for receiving two others, in the event of an enlargement of the reservoirs in the hilly districts, and more power being required for the mills. This extension has not as yet been wanted, as these two wheels are equal to two hundred and forty horse power, and are sufficiently powerful, except in very dry seasons, to turn the whole of the mills.

In the original design, the water-wheels were so placed and arranged, as to communicate their motion to a series of connecting cross-shafts, and by means of large spur-wheels and pinions, to transmit the united power of the water-wheels through large horizontal shafts to a cotton-mill at a considerable distance, and also, by means of a pair of large bevil-wheels and shafts, to keep in motion another mill of equal magnitude in another direction.

These water-wheels are fifty feet in diameter, ten feet six inches wide inside the bucket, and fifteen inches deep on the shroud; the internal spur segments are forty-eight feet six inches diameter, three inches and a quarter pitch, and fifteen inches broad on the cog; the large spur-wheels are eighteen feet two inches and a half in diameter, three inches and a quarter in the pitch, and sixteen inches wide on the cog; and the pinions are the same width and pitch, but are five feet six inches in diameter; the large bevil-wheels are seven feet in diameter, three inches and a half in the pitch, and eighteen inches broad on the cog, their proportions being calculated to convey the united power of all the four water-wheels, should the original design ever be completed.

The water for the supply of the wheels is conveyed from the river Ayr in a canal and tunnel, and from thence along the side of a rising bank to the wheel-house. From this point it is conveyed to the water-wheels by a large sheet iron trough, supported on iron columns.

When viewed from the entrance, the two wheels already erected have a very imposing effect, each of them being elevated upon stone piers; and as the whole of the cisterns, sluices, winding apparatus, galleries, &c., are considerably elevated, they are conveniently approached in every part. Under the wheels is a capacious tunnel, terminating at a considerable distance down the river. The position of the pinions is such, that they gear into each main driving-wheel near the point of gyration.

Water-wheels, on a principle introduced by M. Poncelet, have attained some considerable reputation on the Continent, and as the author has constructed one of them for Mr. De Bergue, it is necessary to allude briefly to the peculiarities it possesses.

The buckets are of a curvilinear form, and are quite open at the back, without any sole-plate; so that they are perfectly ventilated. The water impinges upon them at nearly the lowest point of the wheel, the shuttle being arranged to draw upwards, and as the water enters, it follows the inside cavity of the bucket, rises and falls over into the next in succession, and so on. By this system the force of the water is expended on the wheel itself, instead of losing much of its power in rushing along through the wheel-race, as generally occurs in even well-made undershot-wheels.

M. Poncelet has treated this subject at such length in his able work on water-wheels, that it is not necessary here to enter into further details; but it may be observed, that a practical improvement might be effected, by terminating the lower stone platform of the race somewhat short of the vertical line of the centre of the wheel, as the escape of the water would be facilitated, and the ascending buckets would be more easily relieved of their contents: this is a point of such importance for all wheels, that it must equally apply to this form.

In this paper, the turbine, with the improvements recently introduced in it by Fourneyron, Zuppinger, Whitelaw, and others, has been entirely omitted. There are many published statements relative to these improvements, but its limited employment in this country, up to the present time, scarcely renders it necessary to refer to it. It is, however, asserted, that as much as ninety to ninety-two per cent. have been obtained from M. Fourneyron's turbine; but that gentleman, in a recent visit to this country, kindly furnished the author with data taken from several of his machines, which reduce the duty to a mean of seventy-two per cent. M. Zuppinger and Mr. Whitelaw do not claim a higher duty in their machines, the average being from seventy to seventy-four per cent. upon the theoretical value of the fall.

In the ensuing discussion, Mr. Rennie said, Mr. Fairbairn's experience in the construction of water-wheels was so great, and the general remarks of the paper were so accurate, that little could be added, and he was grieved to disagree with any point in it; but he could not accord with the statement of few improvements having been introduced since the time of Smeaton. He (Mr. Rennie) must claim some merit for his late father, who had carefully studied both the theory and practice of water-wheels, and he would not permit Mr. Fairbairn to detract from his own merit, as he was universally acknowledged to be at least one of the most successful constructors of these machines. The late Mr. Rennie introduced the system of laying the water on to the wheel in a thin stream, not exceeding ten inches in depth. In addition to this, and for the purpose of taking the utmost advantage of the fall, he used the curved moveable shuttle, and at the same time tried various curves for the buckets. It appeared that Mr. Fairbairn had directed his attention to nearly the same points, as there was great similarity in the machines, he having apparently taken the subject up where Mr. Rennie had left it, and the excellent result appeared in the statements contained in the paper. Poncelet's experiments on this subject showed, that in some wheels constructed with curved buckets, but without sole-plates, and receiving the water almost like undershot-wheels, an advantage of ten per cent. over the ordinary forms could be attained. The experiments of the Franklin Institute, made upon large wheels, were perhaps the most valuable. The greatest result obtained was, he believed, about sixty per cent., with a velocity of eight feet per second. As the opinion of Prof. Robison had been quoted, it might not be uninteresting to state, that on one occasion he was consulted by his former pupil, the late Mr. Rennie, as to the best form and dimensions of a water-wheel, and that the result was a complete failure; proving that his practice was not as good as his theory. Some time since it was expected, that the turbine would, in a great measure, supersede water-wheels; but however well they might be adapted for peculiar situations, they had not been generally introduced. Fourneyron brought the idea from Germany, and materially improved upon the construction, until, as he stated, about seventy-five per cent. of power was obtained from them; but Mr. Rennie had never yet seen any turbine perform that amount of duty. Whitelaw's wheel followed, and was stated to have attained about the same power. These machines, however, were both difficult of construction, and did not appear to make progress among engineers.

Mr. Fairbairn regretted that he had not read an account of the improvements of the late Mr. Rennie, both before he had constructed the wheels, and when he wrote the paper, as he could not have failed to benefit by following in the steps of so worthy a predecessor. The turbine had been noticed very cursorily in the paper, because the subject had been nearly exhausted in the excellent paper by Mr. Lewis Gordon,* and because that machine had really been but little employed in this country, and not very extensively on the Continent. He had constructed one for M. Fourneyron, which had been sent to Italy, and was stated to have done good work. He had also made one for Mr. Whitelaw, which had been erected in Yorkshire, for a fall of one hundred and twenty feet. It was at first two feet in diameter, and made about four hundred revolutions per minute, at which speed about thirty per cent. of the power was obtained; it was then altered to two feet six inches diameter, when about fifty per cent. was arrived at; and he believed that other alterations had still further improved its action. Some practical difficulties always occurred, such, among others, as the means of lubricating the main vertical spindle under water, which, for ordinary cases, tended to induce a preference for good water-wheels. Mr. Whitelaw had asserted, that with a good fall, as much as seventy or seventy-five per cent. of power could be obtained; but M. Fourneyron did not anticipate more than seventy-two per cent. He (Mr. Fairbairn) had seen abroad a kind of turbine working horizontally, which received the water through pipes, from a very high fall, into curved buckets, upon the two opposite extremities of its diameter; the velocity was very considerable, and the power gained was stated to be great.

Mr. Croker said, one of the most successful of M. Fourneyron's turbines was erected at St. Blasieu, in the Black Forest, upon a fall of three hundred and fifty feet. The diameter was twelve inches and a half; and when the sluice was open about one-third of an inch, the machine made two thousand two hundred and fifty revolutions per minute, with an expenditure of water not exceeding sixty cubic feet. The supply of water was derived from streams amongst the surrounding hills, and being collected into a reservoir, distant upwards of three-quarters of a league from the turbine, was thence conveyed to it in cast-iron pipes, eighteen inches in diameter. The turbine was used for driving a spinning-factory, containing eight thousand water-spindles, with the roving-frames, carding-engines, and all other necessary machinery. The duty of the machine was calculated, from experiment, to be equal to seventy per cent. of the water expended.

Mr. Glynn said, his custom in the construction of water-wheels had been to obtain free egress for the air, by simple openings through the sole-plate into the interior of the wheel. The contrivance for conveying the air upwards, adopted in the wheels which had been described, was a decided improvement, and would tend materially to that regular filling and emptying of the buckets, without which, uniformity of motion could not be insured, and for many of the fabrics manufactured by water-power that regularity was essential. The ordinary velocity of the wheel was about six feet per second; and with respect to the per centage of power obtained, when the water fell upon the wheel without impulse, and left it without velocity, he conceived that nearly all the power was used. He admired the details of construction of Mr. Fairbairn's wheels, particularly the arrangement for taking the lift on the loaded side of the wheel, and thus making the axle only the means of retaining the wheel in its place.

Mr. Fairbairn stated, in answer to Captain Moorsom, that he considered the form of the bucket did contribute materially to the regularity of motion. It was important to carry the water down as near to the vertical centre as possible, so as to get the best effect from it, and yet to begin to part with it as soon as that line was passed. That form was also found to fill better, and waste less water in times of drought, whilst it worked very easily, and without injury from backwater in times of flood. The ventilating wheels were not so essential for very high falls; they would be more expensive, and as the measure of all benefit was the cost, he should not consider them indispensable for high falls with abundance of water.

Mr. Beardmore thought that there was scarcely a situation in Cornwall to which this kind of wheel was applicable, as all the falls were very high. The wheels in that district were chiefly employed for working stampers, or for pumping. In neither case was regularity of action at all necessary: for pumping, an exertion of force was essential to raise the heavy plunger rods, and then the wheel might run at any velocity during the other portion of its revolution; and before the next stroke was made, power was accumulated by the extra filling of these particular buckets, the others possibly not having been more than half filled; the millwright, therefore, gave plenty of bucket-room, and ventilation was afforded at the extremities.

Mr. Wicksteed considered the wheels in Cornwall and those in Lancashire were so differently employed, that no useful comparison could be drawn between them. He thought, however, that no doubt could exist as to the advantages of Mr. Fairbairn's improvements, where steadiness of action, and the economical use of water, were required. He apprehended that some difficulty might occur in times of flood; but the form of the buckets was calculated to meet, to some extent, even that objection. Great attention appeared to be deservedly given to the angle formed by the bucket with the periphery, and he conceived that it was a question of importance, particularly in relation to the amount of strain upon the axis. He (Mr. Wicksteed) had tried experiments upon large-sized water-wheels, built both on Smeaton's and Rennie's systems, but had not obtained from them more than fifty-six per cent. of power; the velocity was generally about six feet per second.

Mr. Scott Russell had rarely seen better designed or more ably executed machines than these ventilated water-wheels, and he thought the profession was under obligation to Mr. Fairbairn for the improvement he had introduced. He might instance, especially, one point of importance: this was the method of taking off the power, by inside gearing, from the loaded part of the periphery, thus avoiding all risk of straining the wrought-iron tension arms. Attempts had been made to improve upon the system, by taking off the power from the two sides of the wheel; but they had not been successful, as the gearing on both sides did not work well together, and a tremulous motion was communicated, which was very objectionable for spinning-mills, where it was important to obtain the utmost regularity of movement. He had heard it remarked, that the yarn spun by water-power obtained a higher price in the market, than that produced by steam-power. He (Mr. Russell) had tried some experiments on water-wheels, and found the radial breast-wheels give very good results, with a fall of about fourteen feet, and the sluice and watercourse so arranged as to bring the water on with as little velocity as possible, filling the buckets properly, which, however, could only be accomplished up to a certain speed, without a system of ventilation. In high falls this became even more essential, and, in fact, indispensable.

Mr. Fairbairn explained, that he had tried both methods of taking off the power, and preferred taking it from one side only, as, in addition to the other objections, when the gearing was fixed on both sides, the elasticity of the wrought-iron tension arms tended to break the teeth of the pinions. It could therefore only be done when the wheel was perfectly rigid. Mr. Strutt of Derby, and the late Mr. Hewes of Manchester, had made many important improvements in water-wheels, particularly those on the suspension principle, which appeared now to be acknowledged as the most advantageous construction.

Mr. De Bergue said, he had obtained nearly seventy-eight per cent. of power from a breast-wheel, with a good fall, when the periphery was travelling at a velocity of six feet per second. He had erected several of Poncelet's wheels, and thought well of them; indeed, for certain situations he thought they were preferable to any other form, although M. Poncelet had never yet been able to obtain very superior results from wheels erected under his own superintendence. He (Mr. De Bergue) then exhibited a drawing (fig. 2), and explained the construction of a wheel on this principle, to be erected at the Loubregat, near Montserrat, in Catalonia; one of the same kind having been already erected by him at Gerōna, between Barcelona and Bellegarde. The diameter was sixteen feet eight inches, and the width was thirty feet, which, with a fall of six feet six inches, passed one hundred and twenty thousand cubic feet of water per minute, when the periphery travelled at a velocity of eleven to twelve feet per second. An ordinary breast-wheel would require to be ninety feet wide, to use advantageously that quantity of water. It was found that the velocity of the periphery should be about fifty-five per cent. of that of the water flowing through the sluice, and upon these data the power of the wheel would be about one hundred and eighty horse power. The buckets were of a curved form, and made of wrought-iron, one-eighth of an inch thick; and it would be observed, that there was a larger number of buckets than usual, and that the water came upon them at a tangent, through an orifice of such a form and dimensions, as to allow the buckets to fill easily, at the rapid speed at which the periphery passed before the sluice. This great primary velocity was very important, as it caused a considerable saving in the gearing of the mill. The main shaft was formed by a hollow cylinder of cast-iron, four feet six inches diameter, in short lengths, bolted together, and the arms were of wrought-iron, made very light, and of the same form as those of a paddle-wheel of a steamer, and placed very close together. The strain was brought entirely upon the main shaft, and the weight of the wheel was thus reduced to about thirty tons, which was very little for so powerful a machine. The sluice was formed of cast-iron plates, with planed joints, bolted through the flanches, to form one large shuttle, of the entire breadth of the wheel, and its motion was regulated by radial tie-rods, between the stone-apron and the back of the sluice, which could thus be raised with great facility by racks and pinions, and be regulated by the ordinary governor, the weight of the sluice being in a great degree supported by the water flowing beneath it on to the wheel. It moved very accurately between the side-walls of the pen-trough, and cup-leathers at each side prevented any waste of water. This kind of wheel was less affected by backwater than any other form, and the water acted upon it with its full power of velocity, without any impediment from the air in entering, as there was no sole-plate; the buckets were therefore filled and emptied with great facility. He (Mr. De Bergue) was satisfied that this was the best kind of wheel for all falls under eight feet in height, and though the principle differed essentially from that generally taken as the basis of construction of water-wheels, he was inclined to prefer it to any other system.

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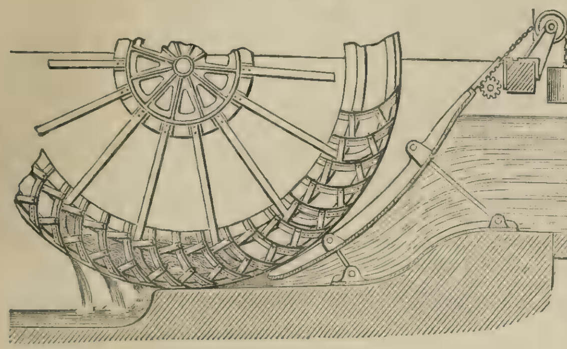
* Vide Minutes of Proceedings, Inst. C. E., 1842, vol. ii. p. 92

Fig. 2.



SECOND REPORT OF EXPERIMENTAL INVESTIGATIONS ON COALS FOR THE STEAM NAVY.*

By Sir Henry De La Beche, C.B., F.R.S., and Dr. Lyon Playfair, F.R.S.

The main points to which attention has been directed in these experiments are—1. The evaporative value of the fuel: 2. Its mechanical structure: 3. The bulk or space which it occupies in stowage: and 4. The chemical identification of the coals operated upon.

With regard to the experimental determination of the evaporative value of the coals, the same processes have been followed as described in our first report. Every attention has been paid to the peculiar characters of each fuel as exhibited during its burning.

It is well known that particular coals require special modifications of the grate, and even of the boiler, to obtain their maximum result. To acquire this knowledge, it would have been necessary to try every different kind under such varying conditions; and it would have been useless, unless a series of experiments had been made, to ascertain the special circumstances most favourable to the coal under examination. The expenditure of money and time which such a course would have involved, rendered its realization quite impracticable. It was, however, possible so to regulate the draughts of air, as to produce those most favourable to the peculiar characters of each coal.

To obtain these conditions, each coal was subjected to experiment for three successive days, the draught being differently arranged for each day. This course was also pursued in the experiments for the first report. It would have been easy, and it might have given the experiments a fictitious appearance of additional value, to have performed all the work of the three days under the same conditions, as the results would have been accordant. But such agreements, while they confirmed the accuracy of the experiments, would have been of no practical value, since they would not have furnished the data necessary to determine the evaporative powers of the coals under varying circumstances of altered draught. The experiments have, therefore, been tried with different draughts, either in the proportions of 4 : 5 : 8, or when circumstances rendered it advisable of 1 : 2 : 4. By experiments with the varying draughts, it became easy to ascertain when the gases escaping from the coals were most economically consumed. The mean of the three days' trials gives, however, more correctly, the average evaporative value in steam-vessels, where the exact draught depends, to a certain extent, on circumstances over which the engineer has little immediate control.

The coals most liable to be influenced by the different adjustments for the admission of air, are those which, from their bituminous characters, are most apt to generate a large quantity of gaseous products on the first application of heat, such as the coals from the Northumberland, Durham, and Lancashire coal-fields; and it has therefore been found, that the experiments made with them, under different areas for the admission of air, vary much more considerably than with the less bituminous coals of the South Wales coal-field. It has even been found necessary in the highly gas-giving coals, such as the cannel coal of Wigan, to allow air to enter behind the fire-bridge, so as to complete the combustion of the escaping gases.

Experiments were made at the suggestion of the late First Lord of the Admiralty, to ascertain how far mixtures of anthracite with more bituminous coals were likely to prove advantageous in the manufacture of artificial fuel. The apparatus used in the manufacture of the contract fuel for her majesty's dockyard, under the patent of Mr. Warlich, having been placed at our disposal, various mixtures, as detailed in the Appendix, were made and tried under the boiler. It was, however, ascertained, that the advantages of these additions were not such as to recommend their adoption. The cementing tar, though partially carbonized by the heat of the coking ovens in which the prepared fuels are heated, was so much more combustible than the dense and difficultly burning anthracite, that the latter remained after the combustion of the former, and it therefore either accumulated on the bars in the state of powder, obstructing the draught, or, falling through the grate, escaped combustion. If thrown again on the fire, it choked the air-way, and impeded the proper action of the fuel. The evaporative power of the fuels thus prepared, was certainly found to increase according as the proportion of fixed carbon was augmented; but this would appear to arise from the fuel then assuming more of the characters of the anthracite, or coke, from which it was made. The results of the experiments pointed to the necessity of keeping an uniform character in the fuel manufactured. These experiments, which do not appear in the annexed tables, will be found detailed in the Appendix.

The following abstract of the working tables will give a general view of the relative value of the coals experimented upon. It must not, however, be taken as the exact expression of their values, without reference to the detailed description of the peculiar characters of each coal given in the Appendix. A coal, for example, may appear by this table to possess a high evaporative power, and yet it may burn so sluggishly, and require so much attention from the stoker to procure its maximum result, that the mere inspection of its evaporative value would give it a higher rank than that to which it is entitled. It is impossible, however, in an abstract to detail all the special characteristics of a coal, and therefore such a table only gives a certain amount of information, and does not render unnecessary a detailed description.

With regard to the manner in which the fuels included in the following table were selected for examination, the same plan was followed as that adopted prior to the former report. Careful inquiries were made at the different ports in the neighbourhood of the coal-fields, as to the kind of coal exported for steam purposes; information from steam-ship companies, in the habit of using the coals of that district was collected, and the local character of the fuel was ascertained. Circulars were then forwarded to the owners of such coals, explaining the object of the inquiry, and requesting them to furnish two tons for experiment. In most instances these were immediately responded to, and the requisite quantity was sent; in a few cases the owners did not furnish the supply necessary. It was not consistent with our instructions to make purchases, as it is usual that the coal experimented on should be delivered free of charge. It is, therefore, possible, that in the coal-fields examined, excellent varieties of fuel may not be included in our list, and this may have arisen either from the circumstance of the owners not responding to our request, or from deficient information furnished to us in our original inquiries. We have constantly endeavoured to rectify any omissions of this kind when pointed out, and the investigation being still in progress, the opportunities for so doing will receive every attention. It is in accordance with this view that we have included in this report various coals from the South Wales coal-field, which have been sent to us since the publication of the first report. The examination has been made, as far as possible, by districts, and, in accordance with this arrangement, the Lancashire and Newcastle coal-fields have principally engaged attention in the present report.

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* For first Report, see pages 30, 50, 74, and 102, P. M. J. Vol. I.

With these observations we would draw attention to the following abstract of the coals examined:—

Table I.—*Showing the Economic Values of the Coals.*

	Names of Coals employed in the Experiments.	Economic evaporating power, or number of lbs. of Water evaporated from 212° by 1 lb. of Coal.	Weight of 1 cubic foot of the Coal, as used for fuel.—lbs.	Weight of 1 cubic foot, as calculated from the Density.—lbs.	Ratio of B. to C., or of the economical to the theoretical Weight.	Difference per cent. between theoretical and economical Weight.	Space occupied by 1 ton in cubic feet (economic Weight.)	Results of Experiments on cohesive power of Coals (per centage of large Coals.)	Evaporating power of the Coal, after deducting for the combustible matter in the residue.	Weight of Water evaporated from 212° by 1 cubic foot of Coal.—lbs.	Rate of Evaporation, or number of lbs. of Water evaporated per hour.—Mean.
		A.	B.	C.	D.	E.	F.	G.	H.	I.	K.
Welsh Coals.	Thomas's Merthyr	10·16	53·0	82·29	·644	55·20	42·26	57·5	10·72	538·48	520·8
	Nixon's Merthyr	9·96	51·7	82·29	·628	59·16	43·32	64·5	10·70	514·93	511·4
	Hill's Plymouth Work	9·75	51·2	84·78	·603	65·68	43·74	64·0	10·18	499·20	531·6
	Aberdare Company's Merthyr	9·73	49·3	81.73	·603	65·78	45·43	74·5	10·27	479·68	489·5
	Gadley Nine-feet Seam	9·56	54·8	83·16	·658	51·75	40·87	76·0	10·46	523·88	517·3
	Neath Abbey	9·38	59·3	83·57	·709	40·92	37·77	50·0	9·65	556·23	546·1
	Gadley Four-feet Seam	9·29	51·6	82·79	·623	60·44	43·41	68·5	10·73	479·36	400·0
	Llynvi	9·19	53·3	80·35	·663	50·56	42·02	...	9·58	429·82	399·5
	Rock Vawr	7·68	55·0	80·21	·685	45·83	40·72	65·5	7·88	422·40	397·5
Lancashire Coals.	Balcarres Arley	8·82	50·5	78·17	·646	54·79	44·35	76·0	9·09	445·91	454·1
	Blackley Hurst	8·81	48·0	78·90	·608	64·37	46·66	65·0	9·00	422·88	500·8
	Blackbrook Little Delf	8·29	51·0	78·16	·652	53·25	43·92	61·5	8·55	422·79	440·4
	Rushy Park Mine	8·08	47·0	80·04	·587	70·31	47·65	67·0	8·35	379·76	419·1
	Blackbrook Rushy Park	8·02	55·3	80·15	·689	44·93	40·50	80·5	8·26	443·50	481·2
	Johnson and Wirthington's Rushy Park	8·01	50·0	80·10	.624	60·20	44·80	69·0	8·16	400·50	454·5
	Laffak Rushy Park	7·98	52·6	84·07	·625	59·82	42·58	75·5	8·16	419·74	435·0
	Balcarres Haigh Yard	7·90	50·8	80·10	·634	57·67	44·13	80·0	8·23	401·32	398·3
	Cannel (Wigan)	7·70	48·3	76·80	·628	59·06	46·37	95·0	8·06	371·91	381·1
	Balcarres Lindsay	7·44	51·1	78·61	·650	53·83	43·83	70·0	7·58	380·18	431·5
	Balcarres Five-feet	7·21	49·0	79·11	·619	61·44	45·71	44·5	7·35	353·29	489·5
	Johnson and Wirthington's Sir John	6·32	51·6	81·73	·631	58·39	43·31	82·0	6·62	326·11	362·7
Newcastle Coals.	Andrew's House (Tanfield)	9·39	52·1	78·86	·660	51·36	42·99	...	9·80	489·21	351·2
	Newcastle Hartley	8·23	50·5	80·27	·629	58·95	44·35	78·5	8·65	415·61	303·0
	Hedley's Hartley	8·16	52·0	81·79	·635	57·28	43·07	85·5	8·71	424·32	300·8
	Bate's West Hartley	8·04	50·8	78·17	·649	53·87	44·13	69·5	8·26	408·43	406·8
	Buddle's West Hartley	7·82	50·6	77·11	·656	52·39	44·09	80·0	8·01	395·69	413·3
	Hastings Hartley	7·77	48·5	78·04	·621	60·90	46·18	75·5	7·96	376·84	404·5
	Carr's Hartley	7·71	47·8	78·23	·611	63·66	46·86	77·5	8·13	368·53	344·3
	Davison's West Hartley	7·61	47·7	78·36	·608	64·27	46·96	76·5	7·83	362·99	402·9
	North Percy Hartley	7·57	49·1	78·29	·627	59 45	45·62	60·0	7·72	371·68	423·5
	Haswell Coal Company's Steamboat Wallsend	7·48	49·5	79·36	·623	60·32	45·25	79·5	7·85	370·66	291·8
	Derwentwater's Hartley	7·42	50·4	78·79	·639	56·32	44·44	63·5	7·66	373·96	451·1
	Original Hartley	6·82	49·1	77·98	·629	58·81	45·62	80·0	6·98	334·86	428·4
	Cowpen and Sidney Hartley	6·79	47·9	78·67	·608	64·23	46·76	74·0	7·02	325·24	350·4
Scotch Coals.	Wellewood	8·24	52·6	79·78	·659	53·57	42 58	80·0	8·39	433·42	438·5
	Eglinton	7·37	52·0	79·84	·651	51·48	43·07	79·5	7·48	383·24	406·2
	Staveley (Derbyshire)	7·26	49·9	79.79	·625	59·90	44·88	88·5	7·40	362·27	466·2
	Conception Bay (Chili)	5·72	...	80.54	...	...	...	...	5·96	...	425·0
	Lyon's Patent Fuel	9·58	61·1	74·73	·817	22·30	36·66	...	9·77	585·33	409·1

The peculiar quality of the coals employed in the experiments is ascertained by chemical analysis. The character of the economic and chemical experiments differ essentially in one respect—viz., that while in the former many cwts. are employed in the experiments, in the latter only a few grains are required. It is, therefore, essentially necessary to take precautions that these few grains represent the average state of the coal. In order to insure this result, a large quantity of the coal is reduced to powder, and is well mixed, by passing through sieves of various sizes. The larger fragments remaining on the wider meshes are reduced to powder, so as to enable them to pass through the finer sieves, and be completely mingled with the remainder. The quantity of coal to be examined is taken from this carefully averaged sample. It is found by experiment, that perfectly accordant results are obtained when small quantities are operated upon, and that imperfect combustion, and therefore discordant numbers, always attend the use of large quantities. These analytical results are placed in Table II. In that table also will be found some valuable analyses of coals from foreign stations, which have from time to time been sent to us from the Admiralty.

Table II.—*Showing the Mean Composition of Average Samples of the Coals.*

	Locality or Name of Coal.	Specific Gravity of Coals.	Carbon.	Hydrogen.	Nitrogen.	Sulphur.	Oxygen.	Ash.	Per centage of Coke left by each Coal.
		A.	B.	C.	D.	E.	F.	G.	H.
Welsh Coals.	Thomas's Merthyr	1·30	90·12	4·33	1·00	0·85	2·02	1·68	86·53
	Nixon's Merthyr	1·31	90·27	4·12	0·63	1·20	2·53	1·25	79·11
	Hill's Plymouth Works	1·35	88·49	4·00	0·46	0·84	3·82	2·39	82·25
	Aberdare Co.'s Merthyr	1·31	88·28	4·24	1·66	0·91	1·65	3.26	85·83
	Gadley Nine-feet Seam	1·33	86·18	4·31	1·09	0·87	2·21	5·34	86·54
	Neath Abbey	1·31	89·04	5·05	1·07	1·60	...	3·55	61·42
	Gadley Four-feet Seam	1·32	88·56	4·79	0·88	1·21	...	4·88	88·23
	Llynvi	1·28	87·18	5·06	0·86	1·33	2·53	3·04	72·94
	Rock Vawr	1·29	77·98	4·39	0·57	0·96	8·55	7·55	62·50
Lancashire Coals.	Balcarres Arley	1·26	83·54	5·24	0·98	1·05	5·87	3·32	62·89
	Blackley Hurst	1·26	82·01	5·55	1·68	1·43	5·28	4·05	57·84
	Blackbrook Little Delf	1·26	82·70	5·55	1·48	1·07	4·89	4·31	58·48
	Rushy Park Mine	1·28	77·76	5·23	1·32	1·01	8·99	5·69	56·66
	Blackbrook Rushy Park	1·27	81·16	5·99	1·35	1·62	7·20	2·68	58·10
	Johnson and Wirthington's Rushy Park	1·28	79·50	5·15	1·21	2·71	9·24	2·19	57·52
	Laffak Rushy Park	1·35	80·47	5·72	1·27	1·39	8·33	2·82	56·26
	Balcarres Haigh Yard	1·28	82·26	5·47	1·25	1·48	5·64	3·90	66·09
	Cannel (Wigan)	1·23	79·23	6·08	1·18	1·43	7·24	4·84	60·33
	Balcarres Lindsay	1·26	83·90	5·66	1·40	1·51	5·53	2·00	57·84
	Balcarres Five-feet	1·26	74·21	5·03	0·77	2·09	8·69	9·21	55·90
	Johnson and Wirthington's Sir John	1·31	72·86	4·98	1·07	1·54	8·15	11·40	56·15
Newcastle Coals.	Andrew's House (Tanfield)	1·26	85·58	5·31	1·26	1·32	4·39	2·14	65·13
	Newcastle Hartley	1·29	81·81	5·50	1·28	1·69	2·58	7·14	64·61
	Hedley's Hartley	1·31	80·26	5·28	1·16	1·78	2·40	9·12	72·31
	Bate's West Hartley	1·25	80·61	5·26	1·52	1·85	6·51	4·25	...
	Buddle's West Hartley	1·23	80·75	5·04	1·46	1·04	7·86	3·85	...
	Hastings Hartley	1·25	82·24	5·42	1·61	1·35	6·44	2·94	35·60
	Carr's Hartley	1·25	79·83	5·11	1·17	0·82	7·86	5·21	60·63
	Davison's West Hartley	1·25	83·26	5·31	1·72	1·38	2·50	5·84	59·49
	North Percy Hartley	1·25	80·03	5·08	0·98	0·78	9·91	3·22	57·18
	Haswell Coal Company's Steamboat Wallsend	1·27	83·71	5·30	1·06	1·21	2·79	5·93	61·38
	Derwentwater's Hartley	1·26	78·01	4·74	1·84	1·37	10·31	3·73	54·83
	Original Hartley	1·25	81·18	5·56	0·72	1·44	8·03	3·07	58·22
	Cowpen and Sidney Hartley	1·26	82·20	5·10	1·69	0·71	7·97	2·33	58·59
Scotch Coals.	Wellewood	1·27	81·36	6·28	1·53	1·57	6·37	2·89	59·15
	Eglinton	1·25	80·08	6·50	1·55	1·38	8·05	2·44	54·94
	Staveley (Derbyshire)	1·27	79·85	4·84	1·23	0·72	10·96	2·40	57·86
Foreign Coals.	Conception Bay (Chili)	1·29	70·55	5·76	0·95	1·98	13·24	7·52	43·63
	Sydney, N. S. W.	...	82·39	5·32	1·23	0·70	8·32	2·04	...
	Port Famine	...	64·18	5·33	0·50	1·03	22·75	6·21	...
	Chirique	...	38·98	4·01	0·58	6·14	13·38	36·91	...
	Laredo Ray	...	58·67	5·52	0·71	1·14	17·33	16·63	...
	Sandy Bay, No. 1 (Patagonia)	...	62·25	5·05	0·63	1.13	17·54	13·40	...
	" No. 2 (Patagonia)	...	59·63	5·68	0·64	0·96	17·45	15·64	...
	Talcahnano Bay	...	70·71	6·44	1·08	0·94	13·95	6·92	...
	Vancouver's Island	...	66·93	5·32	1·02	2·20	8·70	15·83	...
	Colcurra Bay (Chili)	...	78·30	5·50	1·09	1·06	8·37	5·68	...
	Lyon's Patent Fuel	1·13	86·36	4·56	1·06	1·29	2·07	4·66	...

Another more simple means of identification, which it is convenient to record, is obtained by estimating what has been termed the calorific value of the coal. This depends upon the circumstance, that within certain limits of error, the calorific value of a coal may be expressed by the quantity of oxygen required to consume it. This amount is experimentally determined by the quantity of lead which the coal reduces when heated with an excess of litharge, that oxide yielding the amount of oxygen necessary for the combustion of the coal. Properly considered, all combustible matter should be viewed as adding its increment to the calorific result, and as such should be allowed its value; but as the amount of sulphur in coals, although increasing the calorific unit, is objectionable in many respects, it may be considered advisable to correct the table for the quantity of lead reduced by it. This correction is not but may be very simply made for Table III. by the following formula, $\frac{L - (s \times 0\cdot77)}{5}$ in which L is the quantity of grains of lead reduced by 5 grains of coal, s the per centage of sulphur, as shown in column E of Table II.

The correction has not been made, as it is thought better to give the actual result of experiment, and because the correction is within the errors of repeated experiments. In most cases, the error arising from iron pyrites is within 0·1 to 0·19 per cent. of the total lead found; and as this quantity is less than the difference between three successive experiments, it obviously falls within the limits of error, and may be safely rejected, so far as the practical result is concerned.

Table III.—*Showing the Calorific Values of the Coals.*

	Name of Coal.	Quantity of Lead Reduced by one part of Coal.	Oxygen Removed from Litharge by one part of Coal.
Welsh Coals.	Thomas's Merthyr	32·96	2·56
	Nixon's Merthyr	33·20	2·57
	Hill's Plymouth Work	34·06	2·64
	Aberdare Co.'s Merthyr	34·12	2·65
	Gadly Nine-feet Seam	34·16	2·65
	Neath Abbey	31·20	2·42
	Gadly Four-feet Seam	34·24	2·66
	Llynvi	32·24	2·50
	Rock Vawr	28·92	2·24
Lancashire Coals.	Balcarres Arley	29·40	2·28
	Blackley Hurst	29·58	2·29
	Blackbrook Little Delf	28·68	2·22
	Rushy Park Mine	28·98	2·25
	Blackbrook Rushy Park	30·36	2·35
	Johnson and Wirthington's Rushy Park	28·90	2·24
	Laffak Rushy Park	26·88	2·08
	Balcarres Haigh Yard	28·16	2·18
	Cannel (Wigan)	29·74	2·33
	Balcarres Lindsay	26·20	2·35
	Balcarres Five-feet	25·96	2·01
	Johnson and Wirthington's Sir John	23·80	1·84
Newcastle Coals.	Andrew's House (Tanfield)	31·06	2·41
	Newcastle Hartley	31·86	2·47
	Hedley's Hartley	30·36	2·35
	Bate's West Hartley	28·92	2·24
	Buddle's West Hartley	29·54	2·29
	Hastings Hartley	28·56	2·21
	Carr's Hartley	30·90	2·40
	Davison's West Hartley	30·12	2.33
	North Percy Hartley	29·10	2·25
	Haswell Coal Co.'s Steamboat Wallsend	28·80	2·23
	Original Hartley	26·62	2·06
	Derwentwater's Hartley	29·10	2·25
	Cowpen and Sidney Hartley	28·66	2·22
Scotch Coals.	Wellewood	28·38	2·20
	Eglinton	24·32	1·88
	Staveley (Derbyshire)	28·08	2·18
	Conception Bay (Chili)	25·62	1·97
	Lyon's Patent Fuel	31·38	2·43

It may be desirable to state, that the next report will include the remainder of those coals which it is thought expedient to examine. The investigation continues to be conducted in the same manner as formerly, our own superintendence being freely given as heretofore, and the actual practical experiments being confided to Mr. J. Arthur Phillips. Mr. How conducted the chemical analyses until his removal to Edinburgh, after which they were undertaken by Mr. T. T. Philipps.

In acknowledging the kind and liberal support which has been extended to us by those desirous of promoting this inquiry, we would wish more especially to call attention to the disinterested and important aid afforded by Mr. Samuel Hocking, to whose great knowledge of Cornish boilers we are indebted for much valuable information, and for having personally superintended the setting of the boiler employed in these researches.

H. T. De La Beche.
Lyon Playfair.

THE DEFLECTION OF RAILWAY BRIDGES UNDER THE PASSAGE OF HEAVY BODIES.

By Professor Willis, F.R.S.

In these, our notes of Professor Willis's Birmingham lectures, we have endeavoured to give as close a digest of his remarks and deductions as the nature of the subject, and the manner of its treatment, would allow. It is to be premised that, some time ago, a commission was issued from Government for the purpose of investigating the actual results of the application of cast-iron to railways—as in bridges or beams. Professor Willis was a leading member of this commission; and the purpose of the address now under notice was to detail a portion of the results to which this inquiry had led, and the route by which the investigators had arrived at them.

It was found absolutely necessary to ascertain, practically, what were the effects of the passage of heavy loads over iron bridges,—our information being confined to the knowledge of the effect caused by an engine and tender at rest on the bridge,—when the train was in motion, no one knew whether the deflection was greater or less than before.

To determine this great point, a temporary railway was erected in Portsmouth Dock-yard, having an inclined plane, arranged to give any required velocity to the experimental carriage. With this apparatus a long series of experiments were made, the weight of the loads being varied to extremes, and the final ascertained result was, that the statical deflection—or that arising from the weight of the carriage at rest at the centre of the supporting bars—was three or four times less than that caused by the same weight in motion. This result was well illustrated in a small model railway, on which a luggage waggon travelled. The great object being to eliminate all obstructing causes, it was found necessary to commence their experiments on a small scale, and to obtain some other material than cast-iron—some material indeed, that, from its delicacy of texture, would give closer results, and free from the objection of a practical "set." In the more recent experiments, therefore, cast-steel bars were used; and to do away with any irregular pressure of the carriage—it having been found that more pressure was sometimes given to one bar than to the other—one bar only was used. The trial railway was about twenty-five feet long, formed of deal planking, and having at one end an inclined plane about twenty feet high, upon which was an adjustable catch, set to hold the carriage at any required height, and insure accuracy in the starting-point. The bridge occupied the centre of the beam, and the level end was so made as to open outwards, that springs fixed on both sides of the carriage might clasp the sides of the line, and retard the motion, to prevent running off the line altogether.

With the model, the lecturer went through a great number of experiments, with various speeds of movement, always giving the result of a triple deflection of the bar during the movement, compared with that arising from the mere stationary weight. Comparing the model with a full-sized bridge, a great difference is apparent; for, whilst the weight of the bridge is always much more than any passing weight, the weight of the bar in the model was much less. To strengthen the bar, an ingenious plan was resorted to, wherein the weight to be deflected with it was increased, and this showed that the increase in the weight of the bridge diminished the deflection. To take this as a general principle, would, however, involve serious errors, for cases occur where an increase in the weight of the bridge actually increased, in place of diminishing, the deflection. It is, however, to be remarked, that the objectionable facts connected with the deflection of railway bridges, do not exist in practice to anything near the extent hinted at in theory; and, practically speaking, the actual deflection is so slight, that it may be entirely disregarded. This fact the commission has established, by detailed experiments upon a bridge on a railway in Surrey.

Some experiments were also made at Portsmouth, as to the advantage to be gained by curving the bars upwards. By doing this, the centrifugal force was undoubtedly diminished, and the deflection was consequently lessened; but no practically useful fact has yet been elicited.

COTTERILL'S IMPROVEMENTS IN LOCKS.

Amongst the more important mechanical contrivances adverted to in our notes of the Birmingham Exposition, is to be included a peculiarly ingenious and effective lock, the invention of Mr. Edwin Cotterill, of Henry Street, Birmingham, and when we say that it is our impression that this lock cannot, by any possibility, be picked, or indeed opened, by any other contrivance than the actual and original key, its value, as a safeguard, may be, in some degree, comprehended; whilst, to admit of that critical examination, which alone can remove any doubt as to the grounds of our opinion, we give full illustrations of two examples of the mechanism.

All locks which have hitherto come under our notice appear to have been constructed upon the simple principle of throwing as much difficulty as possible in the way of improper attempts to open them; and one or two of the more eminent makers have succeeded, by an almost endless combination of movements, in rendering their locks pretty nearly impregnable, but in none of them is absolute safety insured—whilst the burglar's difficulties are, by their aid, enormously increased, still they do not present what we may consider an impossibility in the way. One notorious instance, indeed, may be mentioned, where, after lavishing expense upon the production of an eminently complex series of movements, the lock was actually, after all, opened by the barrel of a quill. In others, the possession of the proper key, for a few seconds only, admits of an easy mode of entrance, by taking an impression from it, from which a duplicate of sufficient accuracy may at once be made. In Mr. Cotterill's lock, no such objections are met with. If even the works are exposed to view, no opening can be gained by picking; and the peculiar formation of the key precludes all chance of obtaining an accurate impression—and to work the lock a mathematical degree of exactness is required.

In fig. 1 of our engravings, we have given a back view of a padlock on Mr. Cotterill's principle. Here the back plate is removed, and the lock is represented as open. Fig 2 is a corresponding front view of the lock closed, with the cap and the notched locking-ring removed. Fig. 3 is a transverse section at right angles to figs. 1 and 2, with the key in its place. A, Is the case of the lock, containing a cylindrical barrel, B, having a number of radial steel slides, C C, sliding in radiating channels in its face. Each of these slides is acted upon by a small helical spring, D D, pressing so as to force them towards the centre. A circular groove, E E, is cut in the face of the barrel, and of the slides, as at F F, so that when the slides are forced outwards by the key, a continuous circular channel is formed by the coincidence of each of their grooves with that in the barrel's face. When the key is withdrawn, each of the slides is forced in different degrees towards the centre, so that their solid portions intercept the groove in the barrel; and, in this position, the barrel is held fast by a fixed circular ring, G, fitting into the groove, E E, and notched on its face, so as to embrace each of the slides, and in this way the barrel, into the centre of which the key enters, is held fast. The key, H, fig. 4, consists of a cylindrical stem, having a number of inclined grooves cut in its circumference, agreeing with the number of the slides of the lock. These grooves are cut longitudinally in the barrel of the key, and they each vary in depth, slope, and the angle formed by their bottom, with the axis. When placed in the lock for the purpose of opening, the inclined bottoms of the grooves each force out a slide, until the grooves in the latter coincide with the notched ring, G, and the barrel may then be turned by the key in either direction. On the back of the barrel is a portion of a circular ring, I, having in it a space or opening equal to the breadth of the shackle, K, and a groove is formed in the shackle to admit the ring. To close the lock, the shackle is pushed in by hand, at the same time turning the barrel by means of the key, so as to bring the opening in the ring downwards,—the solid portion of the ring passing into the groove of the shackle, and preventing its withdrawal. A reverse turn of the barrel by the key brings the opening upwards, disengaging the shackle from the ring; it may then be drawn out, and freed from its staple by the side opening, as explained in fig. 2, where the shackle is represented as quite clear of the detaining ring. To prevent the entire withdrawal of the shackle, a projecting pin, or stud, is fastened on it behind.

Fig. 1.

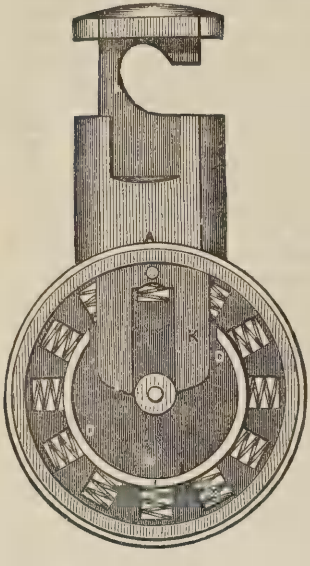


Fig. 2.

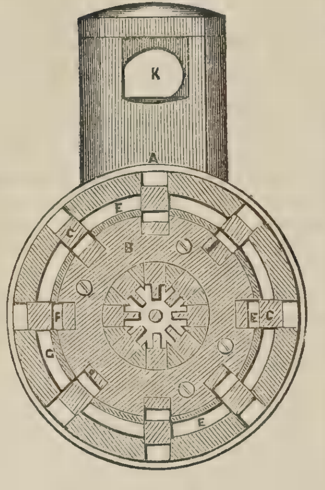
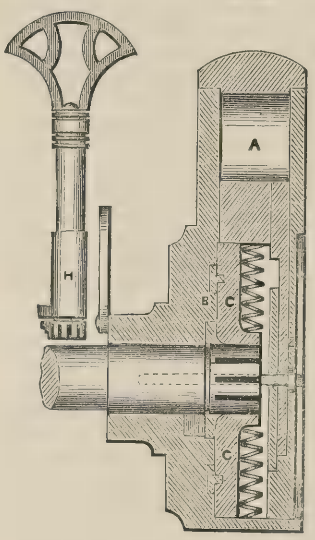


Fig. 4. Fig. 3



In a box or door lock, the arrangement by which the barrel actuates the bolt is different. In this case, an arm is fastened upon the circumference of the barrel, which, in its passage round, acts upon the bolt in the usual way. In doors with latch bolts, the latter is cleverly arranged to slide in a longitudinal groove cut in the lock bolt: thus these parts are much condensed, and the strength of both bolts is applied at one point.

Fig. 5.

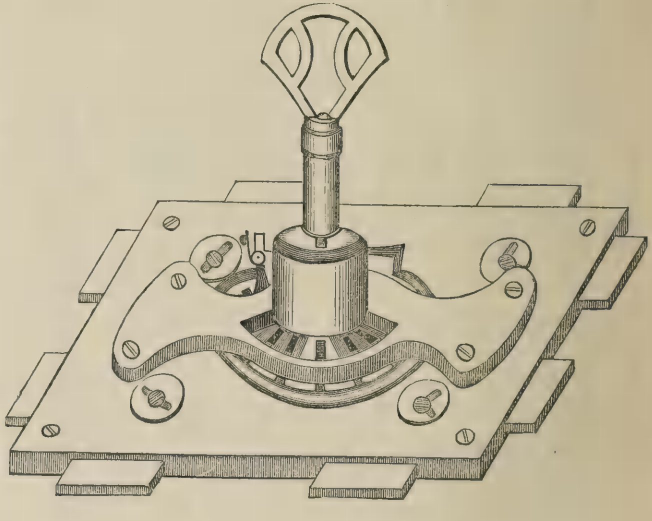


Fig. 5 is a perspective view of a safe-lock, with the front plate removed. It is intended for placing in the centre of the door—having eight bolts, two on each of the four sides, shooting out into the door frame.

This sketch will serve to show how well the mechanical arrangement of locks on this principle is adapted for bank and other safes requiring great strength and security. Should an attempt be made to open the lock with a false key, the slides are projected too far, and are retained in that position by spring catches or detectors, which fall into the groove, so that the true key cannot open the lock until, by a peculiar movement, the detectors are disengaged. Any injury from the violent application of an opening instrument or false key, will not affect the works injuriously, owing to the slides being firmly fixed in deep grooves formed in the revolving barrel, and secured down by a steel ring, which precludes every approach to the movement by any other means than the legitimate key. This is important, when considered in connection with the frequent occurrence of fractures and disarrangements arising from the insertion of a wrong key.

The small bolts merely slide along the grooves, under cover, and return by the pressure of the helical springs, which are equally distributed round. These have a very slight amount of duty to perform, and little chance of "set" is afforded in them; but if this were to occur, there would still be sufficient pressure for action, as the security of the lock rests on the distance the slides are forced from the centre, without reference to their subsequent return. In cases of the occurrence of friction in any part, the provision of a counter one obviates the liability to derangement of action.

The keys are cut in a novel machine of Mr. Cotterill's invention, which may be varied in working to such an extent, that out of the most extensive collection of keys, no two shall be alike. The great feature of the construction of these locks is, that the form of the key itself is not a matter of moment, the locking portion being formed to the key. When a key is lost, the difficulties ordinarily encountered in such a case are here easily overcome. Nothing more is necessary than to take out the grooved barrel of the lock with its slides, and forward it to the maker, who at once inserts a new key, differing from the original, to force out the slides; these are then turned out in a machine, so as to make the grooves agree for the new inclines of the key The new key is then as efficient as the one originally made for the lock—which latter, if found, will not now open it.

When a proper amount of workmanship is bestowed on this lock, we are satisfied as to its correct working; and its security may be calculated from the account we have here given of it.

THE MECHANIC'S LIBRARY.

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Trigonometry, Elements of Plane, 12mo. 1s. cloth. J. Hann.

RECENT PATENTS.

MOULDING METALS.—David Henderson, *Engineer, Renfrew.*

Enrolled September 26, 1849.

Mr. Henderson's improvements have reference chiefly to the production of such articles as are required in great numbers alike, as pipes and cylinders. A two-part box is used, the internal diameter of which is somewhat larger than the pipe to be moulded, so that from two to three inches of space may be left between the pattern and the inner box surface. At the junction, they are each furnished with a lip projecting inward, so as to leave a space between the two lips on each half-box, about the diameter of the intended pipe. The mould—a short piece of a half-pattern—is placed between the two projections just mentioned, which, with the aid of a clasp, retain it in its place until the sand has been rammed between it and the back of the box. This completes a length equal to that of the half-pattern employed; and the latter is then removed further along the box, for a repetition of the process, until the entire mould is finished. The core is made and placed as usual. When the moulds are made of dry sand or loam, instead of green sand, to which reference is here made, the same mould will answer for several castings, as, after the first is taken out, any damage in the mould is repaired whilst it is in a hot state, and a fresh core is placed in it. The mould-boxes are solid, and are pierced with numerous holes to admit of the escape of steam and gases. The patentee states, that various other articles may be cast in the same way.

The claim is a general one, for moulding and casting pipes, cylinders, ridges, and mouldings, as described.

RAILWAY WHEELS.—Chas. Green and Jas. Newman, *Birmingham.*

Enrolled September 28, 1849.

According to this mode of construction, a bar of iron, long enough to form the periphery of the intended wheel, is bent to an annular shape, and the two ends are welded together. This ring is then put into a bed-die, made to receive the flange and rim portion of the wheel, and a top-die, hollowed out to a dome shape, is brought down upon it, so as to bend the upper edge of the ring inwards. This process is repeated several times, each succeeding die having a less curve as the process advances. The last die of the series has a flat acting surface, and is intended to form the flat disc portion of the wheel, with a hole in the centre to receive the nave. This is punched out of plate metal, of a cylindrical form, in two pieces. These are placed over a mandril fixed in the bed-die, at the centre of the wheel. To give it a better chance of a good junction with the disc portion, the edges are left ragged; and it is now acted upon by a set of top-dies to give the weld, a moveable ring being placed round it, between the disc and the bed-die, to confine it during its formation to shape.

The claim is—the mode of manufacturing the peripheries, centres, and naves of railway wheels.

DISTILLATION OF SALT-WATER. W. M'Bride, *Sligo.*

Enrolled October 2, 1849.

This plan involves nothing more than the condensation of the steam of salt-water, by a current of cold air. Amongst the arrangements used for carrying out the process, is a vessel filled with water of a temperature lower than that of the atmosphere, and containing a zigzag tube, placed over a receiver for the condensed steam. One end of this tube is in connection with an exhausting machine, whilst the other opens at a short distance from the supply steam-pipe, descending to the bottom, and passing through it, to terminate in the reservoir beneath. An air-escape pipe is placed at the top of the vessel, and the reservoir has a stop-cock for the withdrawal of the results of condensation.

The atmospheric exhausting apparatus is an ordinary blowing machine, applied as a sucker. Its action is to draw the steam as it issues by the supply pipe into the zigzag tube, in conjunction with a current of cold air, as a means of condensation.

The claim is—the condensation of heated sea-water, brine, or other salt-water, by a current of cold air, which gathers it into a condenser by means of an exhausting or other blowing machine.

REVIEWS OF NEW BOOKS.

WEALE'S RUDIMENTARY WORKS.

Rudimentary Mechanics for the Use of Beginners. By Charles Tomlinson. Pp. 172.

Rudiments of Civil Engineering. Part II. By Henry Law. Pp. 152.

We have here another of Mr. Tomlinson's valuable contributions to Mr. Weale's useful series of rudimentary works, and one which equally as much demands our good opinion as the "Introduction to the Study of Natural Philosophy," by the same author. Were it only for his clearness of expression, Mr. Tomlinson would deserve well at the hands of all stumbling learners, whose young attempts he has essayed to guide; but the balance in his favour amounts to far more than this, for, in the compass of a few small pages, he has compressed the sound practical views of a mechanic, for which we might search in vain through other books of greater pretensions. To select an example of style of treatment, we turn to the last section of the book—hydrodynamics, which is a fair specimen, as far as it goes,—we say as far as it goes, for so little space has been left for this portion, that it has been treated far too briefly :—

> "One of the most intricate subjects to which the laws of motion have yet been applied deductively, is that of *liquid waves.* When any portion of a liquid surface is raised above or depressed below the rest, we have already seen that it will return to the general level, but in so doing it requires a velocity which necessarily carries it beyond the position of equilibrium, and thus produces a series of oscillations, which are communicated in every direction over the liquid surface, each portion receiving its motion from that preceding it, and therefore arriving at each phase of its oscillation a little later than the preceding portion; whence arises the appearance of a form travelling along the surface, which form we call a *wave.* Each wave contains, at any one moment, particles in all possible stages of their oscillation, some rising, some falling, some at the top of their range, some at the bottom; and the distance from any row of particles to the next row that are in precisely the same stage of their oscillation, is called the *breadth of a wave.* Now, as these oscillations are caused by the force of gravity, we may expect some analogy between their laws and those of the pendulum, and accordingly, when the depth of the liquid is diregarded, or considered as unlimited, the wave-breadth (like the pendulum-length) varies as the square of the time of oscillation; so that the time which elapses between the arrival of the crests of two successive waves at a fixed point, is as the square root of the distance between them, or the distance which either of them travels over in the said time; hence it is easy to see that their velocity varies as the square root of their breadth. For instance, if a certain buoy be observed to rise and fall twice as often as another, the waves which pass it must be four times as broad as those which pass the other; but as they travel over this *quadruple* distance in only *double* the time, they must evidently move with a double velocity.* When the water, however, is so shallow that the waves are affected by the form of the bottom, the simplicity of these results gives place to an extreme degree of complexity. The use of these investigations lies in their application to the *tides*, which may be regarded as waves of moderate height, but enormous breadth and velocity, the time of oscillation being half a lunar day, and the velocity sometimes 1000 miles an hour.
>
> "To Hydrodynamics belongs, also, the theory of such machines for raising water as do not depend on atmospheric pressure. Such are the water-screw, invented by Archimedes, the endless chain of buckets, the hydraulic belt,† &c.; but perhaps the most ingenious of

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* "The velocity of waves that run in the same or the opposite direction with a ship, may be ascertained by means of the log, or any other floating body, attached to a known length of cord. By noticing the time that elapses between the lifting of this body, and that of the ship's stern, by the same wave, and adding or subtracting the way made by the ship during that interval, we find the time which the wave takes to travel the length of the cord. In this way it has been found, that in the open ocean some waves travel at the rate of 80 miles an hour; the breadth of such waves is sometimes a quarter of a mile. The utmost difference of level is found by measuring how high above the ship's water-line an eye must be raised to have an uninterrupted view of the horizon. No authentic observations of this kind give more than 25 feet, even in the greatest storms."

† "This machine, the use of which has been revived within a few years, is one of the most efficient of water elevators, yet the most inexplicable in its action. In its ancient form it consisted of a number of hair-ropes, for which a band of flannel, or felt, is now substituted, passing over two rollers, one at the top, and the other at the bottom of the well. By means of the upper roller, it is set in very rapid motion, when the water adheres to its surface in a layer which is thicker the more rapidly it moves, and becomes nearly half an inch thick when the velocity is 1,000 feet per minute. It follows the band to any height, and is thrown off by centrifugal force, in turning over the upper roller."

these is the *water-ram*, by which a stream of water, descending a small depth, is made alternately to open and close a valve, at each shutting of which, a portion of the water is driven up another tube, to a level considerably higher than that from which it originally descended, and is then retained there by a valve.

"To this science also belongs the application of the power of streams and waterfalls to useful purposes. There are five chief means of effecting this, viz., by the *undershot* wheel, the *overshot* wheel, the *breast* wheel, the *horizontal* water-wheel, and *Barker's mill.* The first two are too well known to require a description, but we may observe, that the overshot wheel is always the most advantageous where the height of the fall is sufficient to admit of its use. The smallest rill may be applied in this manner, but the undershot wheel requires a considerable body of water. The breast wheel unites, in some measure, the advantages of both, and is applicable to falls of a medium height, as it requires only a fall equal to its *radius*, and not to its *diameter*, as is the case with the overshot wheel. This wheel is formed with plain floats like the undershot wheel, but the water enters at the level of its axle, and descends round one quadrant of its circumference, which is enclosed for this purpose in a sort of box of masonry. The horizontal water-wheel is used in some parts of France, and is the most applicable to a small fall, and a small quantity of water. Its floats are set diagonally, and may receive the water at one or at several points of its circumference at once. Barker's mill acts on a different principle from any of these, and has not yet been applied on a large scale, though experiments made on models have shown it to be the least wasteful of all modes of applying the power of a waterfall. It consists of an upright tube, from the lower end of which proceed two horizontal branches closed at their ends, and giving the whole the form of an inverted ⊥. This apparatus is movable on a vertical axis, and water is admitted at the top through a funnel; of course, this will produce no motion, because the pressures against all parts of the interior balance each other: but suppose a hole to be made in one side of one of the horizontal arms, the water flows out, and the pressure on that surface which the hole occupies is removed. Hence the pressure on the opposite side of the tube is unbalanced, and causes it to recede in the direction contrary to that of the issuing stream. A similar hole in the other arm doubles the effect.

"In all water-wheels it is a constant rule, that the greatest mechanical effect will be produced when the velocity of the parts driven is just *half* that of the stream driving them; and this is a most important principle, applicable also to the sails of windmills and ships, and the paddles of steamers. It is obvious that the pressure of the wind or water on any of these bodies diminishes as their velocity approaches that of the current, so that if it were possible for a water-wheel to revolve with exactly the velocity of the stream, there would be no pressure on its floats, and consequently no power to drive any other machinery. On the other hand, the pressure is at a maximum when the wheel is standing still, but then having no velocity, it is also powerless. As the power then is proportional to the *product* of the pressure and velocity, it is greatest when they have each their mean value, that is, in the exact medium between these two states,—*rest* and *motion with the current*,—in other words, it is greatest when the velocity is *half* that of the current."

We hope the author will remedy the objection which we have noticed, by giving us another part. The public have certainly got one good shilling's worth, and another would doubtless be acceptable.

Of Mr. Law's production, we are hardly in a position to judge, as we have only the second part before us; but after Mr. Cresy's admirable book, we are pretty well convinced of the comparative inutility of mere hand-books to such an extended science as "civil engineering." Look, for instance, at the list of contents of the single part we have examined; it numbers five heads, each of which would take many such books for its own separate detail. These heads are—Common Roads, Railroads, Canals, Docks, and Bridges. We do not by any means say that any one else could have done better in the allotted space; but we do say, that it is utterly puerile to attempt even an outline of this science within such contracted dimensions.

Both works are profusely illustrated with well-executed plates and wood-engravings, excellently fitted for illustrative detail.

EXTRACT FROM A PAMPHLET, ENTITLED, "REAL CIVILIZATION." By S. B. Rogers, Abergavenny.

This is merely a brick from Mr. Rogers' literary edifice, which, as the title goes on to show, has been erected to illustrate "a serious call to prepare for the advent of a new and perfect organization of human society." Productions of this class are hardly within our reviewing bounds; we shall therefore content ourselves with an extract from the eight pages with which we have been favoured, leaving any of our curious readers to examine the book for themselves.

"Touching impossibilities, what person, having a regard to his reasoning powers, would have presumed, about forty years ago, to assert even the possibility of making a sheet of paper six feet or more in breadth, and a hundred yards in length? Who would have said that fire, or flame, may, as it were, be conveyed through pipes, with the greatest ease and precision, hundreds of miles, and in ramification, in a manner, infinite? That the results of many works and manufactories may, in any specific portion of time, and of some given quality, be quadrupled in quantity, with a reduction in cost of 100 per cent.? That 2000 impressions of a newspaper may be taken, and that by mechanical means, in the course of one hour? That timber may, at a trifling cost, be effectually protected from decay, and yet retain its strength for hundreds of years? That questions may be transmitted a distance of 500 miles, and answers returned to them, in a few minutes of time? That post-office letters would be conveyed from one extreme of Great Britain and Ireland to the other for the insignificant sum of a penny? That compounds may be formed capable of developing, by their explosion, power sufficient to scatter into atoms, as it were, substances of ten thousand times their own relative weight? That ships may be worked at the rate of 200 miles a day, right against both wind and tide? or, that a safe, easy, and pleasant trip may be made from York to London, and back again, with time allowed in the metropolis for both business and pleasure (a distance of 450 miles!), in twenty-four consecutive hours?

"Whoever may have, at the time above mentioned, presumed to assert that even any one of these things may be accomplished, would have been considered by his neighbours a melancholy proof of the twistings and turnings to which the human intellect is sometimes subject; and yet such things are now common, and in daily practice!

"Let no one, therefore, be too precipitate in concluding that the propositions now submitted as fully adequate to remove the numerous evils and miseries of the poor, and the unemployed of the present day, are either impracticable, or even difficult of realization, for the very reverse of such conclusions can be proved to actual demonstration, and consequently, beyond all rational doubt or dispute.

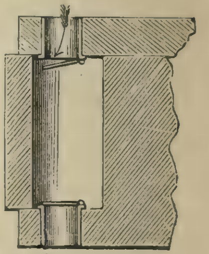
"That all new and great discoveries are, at their births, as it may be termed, treated with a sort of cold contempt or wilful neglect, is an acknowledged truth in all countries where the population is termed civilized; and yet we often see the first people of the land meeting to hail or commemorate the results of discoveries of an exceedingly equivocal character, and hear of thousands of pounds being laid out in 'praising the dead,' who, whilst living, were almost suffered to starve!

"Instances of the cold contempt with which many beneficial discoveries have been received, even from the hands of those who claim to be considered learned men, men of science, may be given that would fill many sheets of paper; I will, however, only mention one relative to the first attempts at steam-navigation:—'When Fulton was in England many years ago, endeavouring to introduce his application of steam-power for the navigation of ships, he was considered a mere quack in mechanics, and absolutely laughed at by many persons who considered themselves competent judges of his invention, for his folly at attempting an *impossibility!* Sir Richard Phillips showed a letter of Fulton's to the late Earl Stanhope, and four or five eminent engineers, stating his successful application of steam to navigation in America, but it was treated with scorn, as descriptive of an *impossibility!*'"

CORRESPONDENCE.

PNEUMATIC PACKING.

Your Journal of September 1st, contains a notice of a species of pneumatic packing by Mr. Moat, and the succeeding number, another method by Mr. Howard of Bolton. The enclosed sketch is intended to illustrate something of the same kind that has often suggested itself to me. The figure represents part of a piston with its metallic ring, behind which there is a space occupied by an india-rubber bag, similar to the Mackintosh preserver, known as "Orion's Belt," fitted with two valves opening inwards on opposite sides of the piston. The upper one is to be kept close by a spring, sufficient to overcome its own weight. On the admission of steam above the piston, the valve would open, as shown in the figure, until the pressure was equalized—it would then close, and remain so until some increase in the working pressure took place in the cylinder. The advantages would be, that it would work with equal effect under all pressures, the demand for extra power of spring, namely, increased pressure, being necessarily accompanied by that extra power; also, the objections urged against the others could not apply in this case.



A MECHANIC.

Glasgow, October 8, 1849.

[The idea of "a Mechanic" is a most ingenious one. Such an arrangement, with a duly proportioned amount of area for steam pressure, in relation to the power required for giving the requisite spring to the piston rings, would no doubt work well.—ED. P. M. JOURNAL.]

PNEUMATIC PACKING FOR PISTONS.

In your Journal for last month I notice a slight error in a letter I addressed to you, respecting Mr. Moat's "Pneumatic Packing for Steam-Engines." It is there stated—"That air at 160°, which is about the temperature of steam at 10 lbs. per square inch, the pressure usual for condensing engines, is expanded about 1·275 times its own bulk," or little more than 1¼ times. This is calculated to mislead by the apparent small expansion which it represents. The fact is, that assuming air at 32° to be 1000, if the temperature were increased to 160°, it would have expanded to 1275, and so on according to the temperature. The mistake has evidently arisen in placing the decimal point, and has no doubt been an oversight; however, as it is incorrect, perhaps you will oblige me by inserting the above in your next valuable Journal.

JOHN HOWARD.

Bolton-le-Moors, Lancashire, Oct. 10, 1849.

PROPORTIONS OF BOILER-GRATES—MODIFICATION OF THE STEAM PISTON.

Engineers do not agree respecting the size of boiler-grates per horse power; some recommend a foot, others a foot and a half, and the Cornish engineers advocate two feet. Now, as there must be a sufficient quantity of the oxygen of the air to support combustion, will not the size of the grate, the area of the space for the flame and smoke, and the height of the chimney, all depend upon each other? If so, will you endeavour to prevail upon some of your engineering friends to give your subscribers a rule to calculate the size of each?

Having a cylindrical boiler of 3 feet diameter, and 15 feet long, will you state the best way to put it up? In all the boilers on the island that I have seen, the space under the lower half of the circumference is divided into three parts—the middle part is to contain the grate at one end, from which the flame and smoke proceed to the other parts, making a circuit round the boiler. In the South Staffordshire iron and coal works, the general practice is to leave all the space under the lower half of the circumference open for the grate and flame, contracting the space beyond the bridge. Which is the plan you would recommend? If I should make an engine-piston hemispherical, top and bottom, the space on the hemispheres of the piston being double the space of the plane surface, what advantage should I gain? Should I not have the steam pressing on double the space, and only losing the steam of a cylinder holding but half the quantity of a cylinder with a plane surface piston, which contained the same superficial contents?

Glen Oille, Isle of Man. Richard Nicklin.

[We leave our correspondent's leading inquiries to be digested by our readers, some of whom will perhaps favour us with their notions on the subject. The latter portion of the communication involves the discovery of a fine specimen of the genus termed by naturalists "mare's nest." It is quite obvious that nothing is gained by the adoption of the hemispherical top and bottom of the piston; for, as all pressure, to be available, must be in the direction of the line of motion of the piston, it is easy to see what amount of surface becomes of no value, from the non-agreement with these conditions. To cut the matter short, the available surface of the modified piston is just equal to that of a piston with a flat top.—Ed. P. M. Journal.]

CHINESE MECHANISM.

On my late return from China, I have observed in one of the back numbers[*] of your Journal, issued during my absence, a letter speculating upon the manner in which the hollow Chinese balls, with loose ones inside, are made; and I conceived it might be interesting to your readers to give a short description of a Chinese lathe, as I have seen them. The supposition of the writer in the *Athenæum*—namely, that the balls are formed in two pieces and cemented together—I received with doubt at the time; for I do not think the Chinese could make such a joint, so as to be imperceptible. With all their skill they have not any notion of working to a straight edge, or of attaining anything like truth in their fittings, or in the outward form of their work. I have seen, also, the tools they use for making these balls, which are merely small pieces of steel wire, bent in the manner A. B. G. describes, and ground to an edge at the point; and although I cannot say I have actually seen the balls made, I know from others that they are made substantially in the way the writer above-mentioned describes.

Fig. 1.

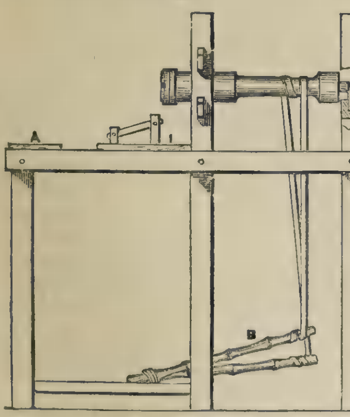
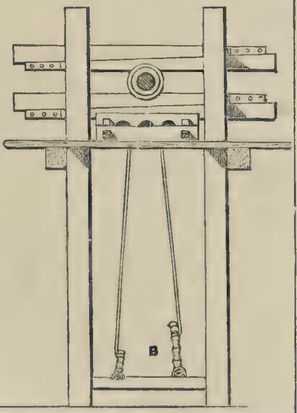


Fig. 2.



I enclose some rough—*very*, you say[†]—sketches of the lathe. Fig. 1 is a side elevation; fig. 2, a front view; fig. 3, a section of the front end of the mandril; fig. 4, an enlarged view of the back end of it; and fig. 5, a perspective view of the rest. The turner sits on the board, A, and so faces the end of the mandril, which is driven with a reciprocating rotatory motion by the bamboo treadles at B. A leather strap, about $1\frac{1}{4}$ inches broad, has its middle coiled round the mandril, and one end fast to each treadle, so that one treadle goes up while the other goes down, and the tool of course only cuts one way. The mandril is a piece of hard wood, hooped with iron at each end; the back end has a piece of round iron, about $\frac{3}{8}$ths of an inch diameter, driven into it, and this has a groove filed round it at C, fig. 3. In this it rests in a notch cut in the edge of a small piece of thick sheet-iron, D, which is let into the cross bar of the frame, shown in section at E, fig. 1. At F, fig. 3, another groove is filed, but *spirally*, of which more hereafter. The front end of the mandril is bored out conically, as in fig. 4, and the work, G, is fixed in by means of a conical wedge chuck, H, in two pieces, and held by friction. Different chucks of course are used for different jobs, but the principle of all is the same. At I, a board is placed across the frame of the machine, which may be called the bed of the lathe; the rest lies on it, but is not fastened down. The fingers of the man's left hand go through the notches in the under part of the rest, by which he is enabled to grip the tool firmly down on the top of it with his thumb, and his right hand holds the handle of the tool. He has great command over it, and indeed must be pretty quick, as the mandril only makes a turn and a half, or two turns, and he has to draw back the tool every time the motion is reversed, which takes place about 250 times a minute. It will be seen that the weight of the man's feet keeps the mandril from jumping out at C. When he wants to cut a screw, the turner shifts the mandril, so that the spiral groove at F rests in the notch; the mandril then receives an end motion, and he is able to cut a thread or two of a screw on his work. Callipers are unknown. To put together the two parts of a chessman, for instance, the inside thread is cut first; the other part is then turned taper, so that the small end just enters the inside thread: an outside thread is then cut to fit the other. This lathe is the same as that used by the brass-turners, and the method of cutting screws by it seems to be the only one they have; for, except among the Chinese in Hong-Kong, who work entirely for the English, I never saw anything else approaching to a screw, or screwing gear, beyond the said lathe.

Fig. 3.

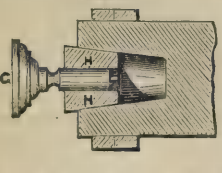


Fig. 4.

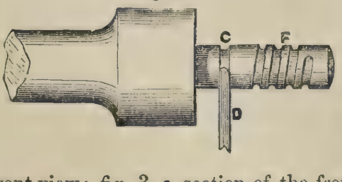
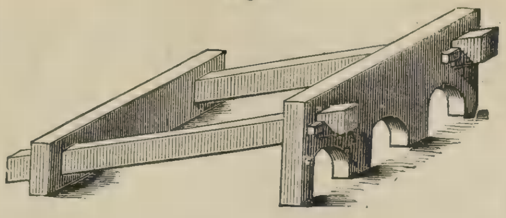


Fig. 5.



Engineer, R.N.

P.S.—Should this prove acceptable, I could send you a description of one or two other Chinese machines, as curiosities.[‡]

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF MECHANICAL ENGINEERS.

July 25.

ON THE SYSTEM OF VENTILATION IN THE WALLSEND COLLIERY.[§]

By Mr. D. Burn, Newcastle.

The Wallsend Colliery is situated about $3\frac{1}{2}$ miles to the east of Newcastle-upon-Tyne. It is celebrated for having been the source of immense wealth to its late proprietors; and from the acknowledged superiority of the coal produced from this mine, arose the practice of appending the term "Wallsend" to such coals as were considered suitable for household purposes, indicating the class to which they belonged.

The seam of coal known by the name of the "Bensham Seam" is found in this colliery, at the depth of 145 fathoms from the surface. Since the opening out of this seam, twenty-nine years ago, there have been several explosions of fire-damp, attended with a great loss of life, fully but unhappily entitling it to the appellation of a "fiery mine." In the course of working this seam, the following explosions and loss of life have occurred, from its opening to the present time:—

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[*] Page 215, vol. i.

[†] Our correspondent does injustice both to himself and us. His sketches, literary and pictorial, do not require any such remark. Of the former, our readers may judge for themselves, as they have passed through our hands almost untouched.—Ed. P. M. J.

[‡] Which we shall have much pleasure in receiving.

[§] In this paper various literal references are made to illustrative drawings; and, although we are not in possession of these drawings, we have retained many of the references as guides to the comprehension of the details of the shafts.

In 1821	1 explosion	52	lives lost.
„ 1832	1 do.	1	do.
„ 1835	1 do.	102	do.
„ 1838	1 do.	11	do.
Total,	4 explosions	166	lives lost.

The total thickness of the seam is 5 feet 8 inches, and it is divided by a band 8 inches thick, consisting of argillaceous shale and splint coal, the coal being 3 feet thick above this band, and 2 feet thick below it; the roof consists of argillaceous shale. The quantity of coal raised annually from this seam is about 68,000 tons; but this quantity is considerably less than the powers and means of the colliery are capable of producing, owing to the present depressed state of the coal trade. There are generally employed in the mine at one time about 210 men and boys, and 15 horses. Another seam of coal, the "High Main Seam," is situated 34½ fathoms above the "Bensham Seam;" this was first opened out in 1781, and it was abandoned in 1831. During that period, five explosions occurred in working the seam, causing the loss of 26 lives.

There are five shafts sunk to the Bensham seam. By two of the shafts the air descends into the mine; and, after circulating through the workings in the manner hereafter described, it ascends by the other three. A furnace is constantly burning at the bottom of each of these three ascending shafts, to produce the draft of air, and keep up an uninterrupted ventilation. These furnaces are 8 feet wide and 6 feet long, and each of them consumes about 1½ tons of coals per day. The descending shafts vary from 7½ feet to 10 feet in diameter, and the ascending shafts from 5½ feet to 8 feet in diameter.

The workings of this mine are divided into nine districts, which have in most cases distinct currents of air for their ventilation, and are in some degree unconnected with each other; a system which was carried out to a great extent in this colliery by the late Mr. John Buddle.

The following are the particulars of the quantity of air that is circulated through each of the districts. The currents were measured with Biram's patent anemometer; and on the day of measuring the quantity of air passing in each of these currents, the barometer at the surface stood at 29·35 inches, and the thermometer at 53°; the wind south-east, morning dull, with the appearance of rain.

In the following description, the "Pillar Workings" are where the whole of the remaining part of the seam of coal is in course of being extracted. The "Air Crossings," where one current of air crosses another current, consist of a brick arch, or a timber erection, by means of which one current of air passes underneath, and the other current above, without any communication between the two currents.

The column of air descending the shaft, supplying the first five districts, consists of 75,960 cubic feet per minute, and is distributed in the following manner:—At a short distance from the shaft the first division of this current takes place; 22,010 cubic feet of air per minute is carried into the first district, which, after ventilating the passages on the west side and the workings at the northern extremity, is again divided; 10,400 cubic feet per minute passing to the first upcast shaft and over its furnace, and the remaining quantity of 11,610 cubic feet per minute, passing into and circulating through the workings forming the second district. On leaving this district, and entering the third district, it is joined by another current, diverted from the main column of air, and consisting of 10,500 cubic feet per minute; this augmented current is then carried through the workings of the third district, and thence over the furnace at the bottom of the third upcast shaft.

The remaining quantity of the principal column of air from the first shaft, now reduced to 43,450 cubic feet per minute, is again divided, where 15,750 cubic feet per minute passes into the fourth district, ventilating the pillar-working, descending and passing from thence into the third shaft by an inclined drift, entering the shaft at the height of about 60 feet from the bottom, and consequently not passing over the burning furnace. The passing of this current of air into the shaft without its coming into contact with the furnace, is rendered necessary from its being on many occasions mixed with fire-damp, or carburetted hydrogen, to the exploding point, caused by the discharge of this gas from the falling of the roof, and eruptions from the thill or underclay of the coal seam.

Of the remaining column of air, 7,500 cubic feet per minute is carried eastward, and along the pipe-drift or gas-drift, to the upcast shaft, diluting in its passage the leakages of gas from the stoppings or walls sealing up the dormant or pipe district, and the discharge of gas from the old workings near its southern exit to the shaft. And 20,200 cubic feet per minute is passed through the workings of the fifth district, and thence to the third upcast shaft; 7,200 cubic feet of which passes over the burning furnace, and the remaining 13,000 cubic feet per minute enters the bottom of the shaft without passing over the fire.

The following is a summary of the different divisional currents of air comprised in the aggregate column descending the first shaft:—

	Cubic feet per minute.
1st and 2d districts,	22,010
3d do.	10,500
4th do.	15,750
5th do.	20,200
Pipe-drift to the second shaft,	7,500
	75,960

The quantity ascending the F shaft being as follows:—

	Cubic feet per minute.
1st, 2d, and 3d districts,	22,110
5th district,	7,200
The quantity passing over the fire being	29,310
Add the quantity passing into the shaft without going over the furnace:—	
4th district entering the shaft by the inclined drift mentioned before,	15,750
5th district entering at the bottom of the shaft,	13,000
Total quantity ascending the F shaft,	58,060

The column of air descending the D shaft consists of 45,400 cubic feet per minute, and is diverted into the following districts, ascending at the A and B upcast shafts:—

	Cubic feet per minute.
The quantity of air passing into the sixth district, ventilating the workings on both sides, and carried to the B upcast shaft,	17,400
The quantity of air carried into the seventh district and pillar-workings, P, and passing by an inclined drift into the A upcast shaft, evading the furnace,	16,800
The quantity passing through the workings of the eighth district, and mixing with the various discharges of gas from the old workings, T T, in its course to the A shaft, being also joined by the current from the seventh district before arriving there,	11,200
Total quantity descending the D shaft,	45,400
Do. descending the C shaft,	75,960
Making a total quantity of air descending into the Bensham seam of	121,360

	Acres.
The area of the coal-field which this system of ventilation comprises is about	400
The area of the workings of the ninth district, which are isolated and closed up to the gas-pipe in the C shaft, as described afterwards, is about	50
Total area,	450

The total length of passages, or air-channels, ventilated by the currents of air already enumerated, amount to about 24 miles in the C pit workings, and 7 miles in the D pit workings.

The total quantity of air circulating through the passages of this mine amounts to 174,758,400 cubic feet per day; and the cost of working the furnaces, including their consumption of coals, amounts to 19s. 1d. per day, or £347 per annum.

The ordinary changes of the atmosphere, as indicated by the barometer, have not the effect of charging any of the currents proceeding from the workings of the whole mine (or air passing over the furnaces), with fire-damp in an appreciable degree; but, under like circumstances, the currents from the pillar-workings and the pipe-drifts are generally heavily charged with carburetted hydrogen, relieved by the change of atmospheric pressure from its vast magazines or gasometers formed by the total removal of the seam of coal.

In the same seam of coal, and situate to the east and south of the C shaft, is the ninth district, coloured green on the plans, which is a district of workings lying dormant, being closed off from the ventilated part of the mine by a line of stoppings or substantial brick walls. The only exit for the gas generated in this district is a pipe, O, carried up in the C shaft to the surface, where the gas burns with great brilliancy. When last measured, the quantity issuing from this pipe was found to be about 95 cubic feet per minute; an amount nearly equal to half the consumption of the town of Newcastle.

Some time ago the idea was entertained of lighting the town of Newcastle with the gas generated from this source; but on experimenting, it was found that its illuminating power was so exceedingly low, as to render it utterly useless as an economic light. However, since the present proprietors leased the colliery, the attention of Dr. Richardson, the eminent chemist of Newcastle, has been called to the subject, the result of which was, that he suggested the use of a very simple and cheap ingredient containing a large quantity of carbon, by passing the gas through which its illuminating power was raised to a point fully equal to the best coal-gas, together with a large increase in volume. The quantity of gas might be increased to a great extent by barring off and piping the gas from other parts of the mine; and the subject of beneficially employing the gas is at present under consideration.

The following is the analysis of the gas issuing from the gas-pipe in the C shaft, and the gas evolved from the workings of the Bensham seam—(vide the reports of Sir H. T. De la Beche and Dr. Playfair:)—

	Pipe.	Workings.
Carburetted hydrogen,	92·8	73·9
Nitrogen,	6·9	24·9
Carbonic acid,	0·3	1·2
	100·0	100·0

Since the present proprietors commenced working this mine in 1847, they have instituted the general use of the Davy-lamp, to provide not only against the ordinary risks of the working of a "fiery mine," but also the risk from sudden eruptions or discharges of gas, now well known to have caused so many of the great explosions that have unhappily occurred in this coal district.

Appended is a copy of the rules and regulations, which are strictly enforced respecting the use of the safety-lamp, and the precautions to prevent the risk of explosion in the working of this colliery:—

Rules and Regulations to be observed by the Officers and Workmen of the Wallsend Colliery.

Any person observing any door standing open that ought to be shut, any stoppings injured, brattice knocked down or broken, or any other circumstance whereby the ventilation of the mine may be deranged or obstructed, is immediately to inform the overman or deputy, or other person then in charge of the pit.

No hewer to commence working in any place, until it has first been examined by the overman or deputy, or other authorised person.

No workman to work in any place where he considers the timber, &c., insufficient to support the roof of the mine, or any other cause that may render the place unsafe, until the deputy or other person has made it secure.

The overman, deputies, or other inspector appointed for that purpose, shall carefully examine and lock every lamp previous to its being taken from the cabin or station, and any person having an imperfect or broken lamp is not to be allowed to pass to his employment until he shall have given a satisfactory reason for any such damage; but, if caused by carelessness or neglect, he is not again to resume work until the case is laid before the viewer.

Every person who has the use of a lamp shall take home the gauze thereof, for the purpose of its being properly cleaned before it is again used.

No person, on any pretext, to leave the cabin or station until the deputy or other inspector has examined and found his lamp to be perfect.

The hewers to hang their lamps at such a distance from where they are working, as to prevent the possibility of their being injured by splinters from the coal or other casualties.

No putter, pony-driver, or helper-up, is, under any pretext whatever, to carry a lamp during his work; a sufficient number will be placed in the going roads to afford light for the performance of the work.

Any person seeing another using his lamp in an improper manner, is strictly enjoined to inform the overman or other person in charge of the pit.

All persons are hereby strictly prohibited from interfering in any way with their lamps, further than the necessary trimming of the wick with the picker.

Any person losing his light is to send his lamp out by the proper person appointed for that purpose, but not to be again used until it is examined.

Any hewer or other workman getting any blower or sudden discharge of gas, or observing, by the usual indications, the presence of fire-damp, is immediately to draw down the wick of his lamp; and, should the fire-damp inside the gauze continue to burn, to protect it from the current by his clothes or other means, to apprise the men and boys working near him, that their lamps may be likewise extinguished, and to retire into the fresh air by the intake air-course, if possible, until the overman or other person then in charge of the pit is informed of it.

Any person acting contrary to these regulations shall be immediately turned from his employment, fined, or prosecuted according to law, at the option of the owners or their viewer, the safety of the lives of the workmen depending upon the strict observance of these directions; and all parties are enjoined to aid in the detection of any such offenders.

Mr Clift observed, that he was aware such an application had been proposed of the waste gas from coal mines, but it was proved not to be of sufficient illuminating power for use in lighting a town. The plan suggested to obviate this defect was by charging it with coal-tar naphtha, for the gas generated in the mine was the sub-carburetted hydrogen, and was deficient in the element of carbon; hence, though it burnt very freely, it yielded but little light. If, however, it could be collected in sufficient quantity, and with due regularity, it might easily be rendered available for street illumination, by putting a small sponge-box on the burner; and by the gas passing through a sponge saturated with naphtha, it would acquire considerable brilliancy. There was at the present time a similar discharge of gas in the neighbourhood of West Bromwich; but in that case also there was a deficiency of illuminating power.

Mr. Gibbons expressed a doubt whether the plan of working the mine, as detailed in the paper, was not inferior in economy and efficiency to the mode adopted in Staffordshire; and he thought, if the number of shafts were increased, the facilities for ventilation would be much greater. He stated that his coal mine was ventilated easily by a stream of air along the face of the workings, with several outlets at the top for the gas to escape; a great portion of the gas was carried in a stream at the top without mixing with the air, on account of its lightness, and a much less quantity of air was required in proportion, in consequence of the gas being so much less diluted with air. In that case, however, the seam of coal was very much thicker; the total thickness of the seam was 24 feet, and it was worked in two heights of 12 feet each.

Mr. Slate remarked, that the collieries in the north were of much greater extent than those in Staffordshire, which were usually not more than about 20 acres in extent: the former were also generally of greater depth, and sinking the shafts was very expensive and difficult, on account of the depth and the hardness of the strata.

Mr. Clift observed, that the excellent plan of ventilation which had lately been introduced, of using jets of high-pressure steam to propel the air through the workings, was found to be very successful. He had employed steam jets for the purpose of emptying gas-holders, and he was astonished at the short time in which the gas could be expelled from a large gas-holder by that means.

ROYAL SCOTTISH SOCIETY OF ARTS.

April 30, 1849.

The Royal Scottish Society of Arts met in the Hall, No. 91 Prince's Street, on Monday, 30th April, 1849. The following communications were made:—

"On Improvements in Fixed and Revolving Lights, being a new Diacatoptric Instrument for increasing the intensity of the light." By Thomas Stephenson, Esq., F.R.S.E., C.E.

The author stated that this instrument is composed of three parts—a paraboloidal mirror, having the conoidal portion behind the parameter cut off, and its place supplied by a hemispherical reflector, whose centre thus coincides with the focus of the paraboloid, while in front of the flame is placed an annular lens, subtending at the focus of the paraboloid, the same angle as that which is subtended at that point by the greatest double ordinate of the reflector, and having its principal focus coincident with that of the paraboloid. This instrument should theoretically produce the most intense light yet derived from any given flame, as it encloses and parallelizes each ray of the whole sphere of light, so that none are lost by divergence between the lips of the reflector, where, in the present arrangement, not very much short of one-half of the light is lost. In this instrument the hemispherical reflector throws the light which it receives (viz., the posterior half of the sphere of light) through the focus of the paraboloid; and while the outer ring of this light is received by the paraboloid, and parallelized by it, the central cone is received by the annular lens, and is also parallelized. The outer ring of the anterior half of the sphere of light is received directly by the paraboloid, and is parallelized by it; while the central cone of rays, which, in the present arrangement, is lost by natural divergence, is received by the annular lens, and is parallelized by it. Thus the whole sphere of light is economized. This combination may also be applied, *mutatis mutandis*, to the illumination of half of the horizon of a fixed light, by means of a single light: the only difference being the substitution of two truncated parabolic conoids for the paraboloid, and a reflecting belt for the lens. Two of these instruments directed to opposite points of the compass would light up the whole horizon.

Another new form of lighthouse apparatus was also described, by which the whole sphere of rays can be parallelized by means of a hemispherical reflector placed behind the light, and an annular lens, and a series of concentric totally reflecting glass zones also placed in front, and receding from the lens back to the reflector. These zones are also new in themselves, as they have the property of parallelizing divergent rays, not only in a vertical plane like the zones in Fresnil's fixed lights, but also in every plane whatever.

"On Workmen's Houses in Town Districts, with Plans, Elevations, Details, and Description of the 'Lumsden Model Dwellings for the Working Classes,' erected in Glasgow." By James Wylson, Esq., architect, Glasgow.

The author stated that these model dwellings have been especially calculated for towns, where ground is too expensive to admit of the separate cottage plan being available; yet, from the concentration of conveniences contained in them, and the economical arrangement of these in regard to space, presenting elements of improvement and economy applicable to cottages. The particulars are as follow:—

The building is four stories high; the ground-story contains a sub-factor's house and six others; the three upper stories contain eight houses each, arranged on each side of a central passage. The latter is lit at each end; also, the floor of it is grated for about six feet at each end, to admit of free ventilation to the roof, where there are two corresponding lowered openings. At the back, on the ground-story, is a wash-house, with three pair of tubs, three boilers, and a centrifugal drying machine; affording each tenant an opportunity of washing clothes once in about every ten days. There is also a bath-house, for plunge and shower bathing.

Each house is contained in a clear space of 18 by 15½ feet.

There is an entrance-lobby to each, 4 by 3¼ feet, with water-closet, of good size and ventilated; the apparatus simple and strong.

The main apartment (which is more room than kitchen) contains a clear space of not less than 132 square feet, by 9 feet high; besides—

1. Two bed-closets, in corners diagonally opposite to each other, and containing each a bed-bottom, 6 feet by 4 feet, being a frame of angle-iron, filled in with iron-hooping, webbed, with dressing-space in front of the same, averaging 11¾ square feet. One closet is enclosed with a partition 7 feet high only; the other is enclosed to the ceiling, but with an opening over the door from door-frame to ceiling, both thus admitting the free circulation of the air of the main apartment over them; each has a shelf for bandboxes, &c.

2. A scullery, containing a dresser with two drawers, shelves above for dishes, &c., and rack below for cooking utensils; a press with three tier of shelves; a coal-box to contain 12 cwt. of coal; a sink with water laid on; and a clear working space 5½ by 3½ feet.

3. A larder in outside wall, with window-frame filled with perforated zinc, and door on inner side.

4. A cooking-range in 3 feet fire-place, with oven, open fire, and boiler.

5. The hearth to fire-place of cast-iron, with low segmental fender cast with it; and in the bottom an ash-box covered by a grating—for the economy of fuel.

6. The lower sash only of main window hung, but a transom and louvre board for ventilation above the upper sash: the lower one easily brought inside to facilitate the cleaning of both.

The rent (which is payable quarterly, in advance) is £6 10s., including gas, water, and all other rates, excepting the poor's rate. The gas is supplied in the evenings till eleven o'clock throughout the year, being turned on during the several months as follows:—

January,	5 o'clock.	July,	9 o'clock.
February,	6 "	August,	8 "
March,	7 "	September,	7 "
April,	8 "	October,	6 "
May,	9 "	November,	5 "
June,	10 "	December,	4 "

Notice is given by turning it half off 5 minutes before 11, the meter being in the sub-factor's house. A jet is burned all night in the central passage on each floor.

"On an Improvement in the Expansive Steam-Engine." By Mr. John Charles Pearce, Salford, Manchester.

The improvement contemplated by the author is stated to consist in the application of two self-acting valves, in addition to the expansion regulator, one to each end of the steam-cylinder, fixed in suitable passages, which communicate with the waste steam or exhaust pipe. He states that the use of these valves is to prevent the pressure upon the working side of the piston from falling below the resistance or back pressure upon the opposite side—a very common occurrence in carrying out the expansive principle, although attended with very considerable loss of power; and that the proposed improvement is chiefly adapted to locomotives and other non-condensing expansive engines, where the power is extremely variable.

"On a New Air or Stink-Trap, for preventing noxious Effluvia proceeding from Drains and Common Sewers." By Mr. James Robb, Gas Works, Haddington.

The model is a box, wider at the top than at the bottom, and having a strip of leather fixed round the lower edge, to assist in making an air-tight joint with the valve.

The valve is a flat piece of iron, made large enough to cover the bottom of the box, to which it is attached by a hinge on one side, which also forms a lever, on which is hung a balance weight, for the purpose of bringing it into close contact with the bottom of the box.

When fitted into the mouth of the drain or common sewer, and covered with an iron grating, the author stated that it becomes an efficient protector in all weathers, especially as it does not depend on water, for preventing the foul air from blowing through.

Referred to a committee.

"On a Self-acting Water-Meter." By Andrew Carrick, Esq., Holmhead Street, Glasgow.

The author stated that this meter is a close vessel of any size; that the water is introduced through a valve, and when it reaches up to the bend of a fixed syphon, it is discharged into a receiver below; that the valve is closed while the discharge continues, by means of a beam on a fulcrum inside the meter; to the ends of this beam a chain connection is made, so that the valve is drawn up by the superior weight of water flowing through the syphon into a perforated bucket. The number of discharges is indicated by wheel-work similar to a gas meter, the movement being obtained from the arbor that carries the beam. The end of this arbor comes out through the meter, and works a ratchet-wheel, with a pinion of ten leaves on its axis.

"On a New Valve Nose-Cock, suitable for Brewers' Coppers, Kitchen-Boilers, Hot-Water Apparatus, &c." By Mr. Daniel Erskine, plumber and gas-fitter, Clerk Street, Edinburgh.

The author stated that this valve-cock is superior to the common cocks either for steam or hot water. It is fitted with a valve that neatly fits the case; the spindle is fitted with a spiral spring, which makes it self-shutting, and the spindle passes through a stuffing-box. The advantage was stated to be, that it will last much longer than the present cocks; and that, when made on a large scale, for brewers' coppers and other purposes, it will not cost one-half so much as those presently in use. Each large cock to have one spare valve and valve-socket, in order that the old valve may be removed to be ground tight when necessary, the new valve supplying its place in the meantime, so that there may be no stoppage in the use of the coppers, &c.—Mr. Erskine presented the cock to the Society.

"On a Railway Signal, and method of working it at a considerable distance from a station." By Mr. Robert Sheldan, Hawick Junction, North British Railway, near Portobello.

"On a Time-Piece moved by a Spring of Vulcanized Caoutchouc." By Mr. William Smith, clock and watchmaker, Musselburgh.

This time-piece was exhibited in action. The author stated that he conceives the superiority of this spring to consist in its perfect invariability, from the absence of friction, and the simplicity of its application, being in the form of a ring, one end of which is passed through a piece of steel with an eye, to which is attached a hook connecting it with the pulley, both ends being fixed at the bottom of the column by a steel pin passed over them.

A working model of Mr. Daniel Erskine's Hydraulic Locomotive and Railway being now finished, Mr. Erskine exhibited it in action, as also his Revolving Syphon.

GLASGOW PHILOSOPHICAL SOCIETY.

APRIL 18, 1849.

"On a Peculiar Fibre of Cotton, which is incapable of being Dyed." By Walter Crum, Esq., F.R.S., Vice-President.

In the month of May last, Mr. Thomson, of Primrose, received from Mr. Daniel Kœchlin, of Mülhausen, some specimens of a purple-ground printed calico, each of them containing a portion of cotton which was white, although subjected to the same treatment by which the rest of the cloth, and even the threads which crossed the white one, was uniformly dyed. The white part of the thread was usually thicker than the rest, and little more than a quarter of an inch long. The whole fabric had been thoroughly bleached before printing, so that it contained no grease or other impurity that could resist the colouring matter.

White specks like these are not unknown or undreaded among the printers of calicoes in this country. Mr. Kœchlin mentions that the cotton of which they are formed is known by the name of *coton mort*, and here also it is called *dead cotton*. Mr. Kœchlin has been the first, I believe, to suggest that it may consist of unripe cotton, and that its fibre may be solid, wanting the hollow of the more perfect fibre. He adds, that if such should prove to be the case, its behaviour with colouring matters may affect materially the question of the mechanical or chemical nature of the union of cotton with its dye. Mr. Thomson did me the honour to transmit me the specimens for examination.

The ordinary cotton fibre, it will be remembered, is described by Mr. Thomson in the memoir where its form was first made known,* as a tube, originally cylindrical, but which collapses in drying. It has then the appearance of two small tubes joined together, so that a transverse section of the filament resembles in some degree a figure of 8. Until full maturity, the cylinder is distended with water, in which bubbles of air are often distinguishable.

On placing a few of the fibres of the *coton mort* under the microscope, I found them to consist of very thin and remarkably transparent blades, some of which are marked or spotted, while others are so clear as to be almost invisible, except at the edges. These fibres are readily distinguished from those of ordinary cotton by their perfect flatness, without the vestige of a cavity, even at the sides, and by their uniform as well as great transparency. They are often broader, too, than the usual fibre, and they show numerous folds, both longitudinal and transverse, but they are never twisted into the cork-screw form of the ordinary fibre.

It occurred to me that cotton of this description might be detected among the wool as it is imported. I searched accordingly for any portions that had a different appearance from the rest, and having collected and examined them, I found one sort whose filaments had exactly the appearance, under the microscope, of the *coton mort* in the pattern of Mr. Kœchlin. It occurs in the form of a small matted tuft of a shining silky lustre, and usually contains in its centre the fragment of a seed, or perhaps an abortive seed. It consists of short fibres, having little tenacity. Specimens of it are found in abundance among the motes or hard portions, called droppings, rejected by the picking machine in the preparation for spinning. Small tufts of it, however, do occasionally pass the sifting process of the picking machine, and then, their fibres being too short to be teazed out in the carding engine, or drawn into threads in the subsequent operations of cotton spinning, remain as minute lumps or knots upon the threads of better wool.

Although the microscopic appearance of the fibre in question is that of a flat single blade, the cellular character of the tissue scarcely admits of such a formation. We must rather suppose that, like the healthy unripe cotton fibre, it was originally an elongated cell or tube filled with liquid; that the seed around which it began to grow had died soon after its formation, while the fibres which clothed it were yet soft and pliable; and that the flattening, and perhaps growing together of the sides of the tube was occasioned by the pressure from the increasing crop of cotton attached to the numerous other seeds confined in the same pod.

To explain the bearing of this peculiar structure upon the question, whether cotton-wool and colouring matters form together a true chemical compound, or are held together by a merely mechanical power, I must quote a passage from a memoir on this subject, which I read to the Philosophical Society six years ago, and refer to the memoir itself for additional illustrations:—

"In many of the operations of dyeing and calico-printing, the mineral basis of the colour is applied to the cotton in a state of solution in a volatile acid. This solution is allowed to dry upon the cloth, and in a short time the salt is decomposed, just as it would be, in similar circumstances, without the intervention of cotton. During the decomposition of the salt its acid escapes, and the metallic oxide adheres to the fibre so firmly as to resist the action of water applied to it with some violence. In this way does acetate of alumina act; and, nearly in the same manner, acetate of iron. The action here can only be mechanical on the part of the cotton, and the adherence, as I shall endeavour to show, confined to the interior of the tubes of which wools consist, or of the invisible passages which lead to it. The metallic oxide permeates these tubes in a state of solution; and it is only when its salt is there decomposed, and the oxide precipitated and reduced to an insoluble powder, that it is prevented from returning through the fine filter in which it is then enclosed.

"When the piece of cotton, which, in this view, consists of bags lined inside with a metallic oxide, is subsequently dyed with madder or logwood, and becomes thereby red or black, the action is purely one of chemical attraction between the mineral in the cloth, and the organic matter in the dye vessel, which, together, form the red or black compound that results; and there is no peculiarity of a chemical nature from the mineral constituent being previously connected with the cotton."

To produce the purple dye of Mr. Kœchlin's pattern, the cloth has first to be impregnated with iron. For this purpose it is made to imbibe a weak solution of proto-acetate of iron, and afterwards dried. By exposure to the air for some days the salt is decomposed. Its acetic acid evaporates, and the oxide of iron, then become peroxide, remains in the fibre. The cloth is afterwards subjected to severe washings in hot and cold water, but its iron is not removed; and the question is, How is it retained in connection with the cotton? Mechanically, as I maintain, and probably in the interior of its hollow fibre, which it entered in a state of solution, and within which it was precipitated. Others, as I have already stated, are of opinion, after Bergman, that the combination is a chemical one; and so fully is that view carried out by my friend Professor Runge of Oranienburg, in his ingenious and excellent work on the chemistry of dyeing,* that he assumes coloured cottons to be combinations of what he calls cottonic acid with the various bases, in definite and even in multiple proportions. Thus a very pale shade of buff from oxide of iron, is called *percottonate of iron;* another is called *bicottonate of iron;* and still deeper shades, *cottonate* and *basic cottonate of iron.*

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* Annals of Philosophy for June, 1834. Lately reprinted in the Classical Museum, No. 20, and in Liebig's Annalen for January, 1849.

But the new fibre, by the same treatment, is incapable of retaining the iron mordant, and yet both fibres have the same chemical composition, and the same ultimate structure. The only difference is, that one is shaped into tubes or bags capable of holding all matters which are insoluble in water—that is, all bodies that can be caught upon a filter, while the other is possessed of no such enclosure.

I take this opportunity, in reply to a review of my first memoir on this subject, by M. Persoz, in his remarkable work, "Traité de l'Impression des Tissus," of explaining, that I attribute to an attraction of surface those cases of dyeing where pure cotton, by mere immersion, is enabled to decompose the solid matters in solution, and to withdraw them from the solvent. Such is the case with the solution of deoxidized indigo in lime—with the plumbite of lime—with the various salts of tin, and many other solutions. Cotton, as I have stated, acts in these cases like charcoal and other porous bodies, and I have seen no reason to confine the attraction in question to the internal surface of the cotton fibre.

But I have not ranked the aluminous mordant among the class of bodies so attracted, because cotton, when immersed in a solution of acetate of alumina, has not the power of separating its basis. That solution must be applied to cotton and dried in it, and then the alumina only adheres, or loses the power of being washed away, in proportion as the acetic acid is removed by evaporation. I could see here no chemical decomposition effected by the cotton-wool, for the same salt may be decomposed by evaporation in a glass vessel. In this case I have represented the alumina as being held in the interior of the fibre, just as sand may be held in a bag whose interstices are too narrow to allow its particles to pass.

M. Persoz has remarked, however, that by evaporating a solution of acetate of alumina in a glass vessel, we do not so thoroughly decompose it as by drying the same substance upon calico. This I also have observed; and although I have been accustomed to ascribe the difference to the more extensive division and exposure of the salt upon cotton, I have no proof, and shall not deny, that the presence of cotton at a particular stage of the evaporation may accelerate the decomposition of the salt, and that its fibres may thus attract a portion of alumina over their whole surface. If this modification of the view I had given be correct, the action of the *coton mort* proves at least that colouring matter adhering outside is not so permanent as that which is held within the fibre of the mature cotton.

Neither view gives any countenance to the chemical theory. Porous bodies are well known to attract, and even to decompose, without chemically combining with the substances they precipitate. Accordingly, none of the oxides are changed either in colour or in chemical character by their union with cotton. The hydrated oxide of copper, for example, precipitated upon calico, becomes carbonate or arsenite when exposed to carbonic or arsenious acid. The protoxide of iron changes speedily in the air into the red sesquioxide, and that again may be converted into prussian blue, or into a black or purple lake—every new compound, if it only be insoluble, adhering firmly to the wool.

MONTHLY NOTES.

Wilkins' Spring Weighing-Machine.—Mr. Wilkins, the eminent lampmaker of Long Acre, London, has recently registered an ingenious counter-weighing machine for general purposes, wherein a double bow-spring is employed as the weighing medium. The scale-pan is hung to one end of a double lever, which oscillates near its centre, upon a fulcrum carried at the top of a neat standard or pedestal. The opposite end of the lever is jointed to the upper end of a double bow-spring, the lower end being fastened to a short bracket carried by the standard. Near the centre of motion of the lever, is fastened upon it, a curved rack, hinged at one end, and pressed up at the other by a spring, so as to gear with the teeth of a pinion on an index-shaft above, so that the weight of any article deposited in the scale-pan is at once denoted by the position of the index-finger upon the dial-plate at the top. The construction of the machine is very simple, and it may obviously be applied to various classes of weighing machines.

Careless Engine-Driving.—A melancholy accident has just occurred on the Whitehaven and Furness Railway, the attendant circumstances of which are such, that we are driven to the conclusion, that either gross carelessness, or incompetency on the part of the driver, has alone been the cause. It appears that the unlucky train was on its passage towards Whitehaven, and when near the station, great surprise was excited at the speed being kept up, and still more when the train rushed up to the station, dashed through it, and finally lodged in the house of a schoolmaster standing beyond the termination of the rails. In addition to the excessive damage occasioned by the destruction of the kitchen of the house and other appurtenances, one of the inmates was killed on the spot, and another most seriously injured. We can ask now, after the occurrence of this fatality, why was there no stationary buffer at the termination of the rails?—and if the directors had asked this question previously for themselves, we might have been spared the task of recording the present casualty. From the information we have received, it appears that there was absolutely nothing to stop the run where the rails ended, although the station is placed at the termination of a three-mile incline. It is quite true that the gradient is a comparatively slight one, but it would appear to be sufficiently great to justify the engine-driver, at least in his own mind, for laying some of the blame upon it. He states that the frost of the preceding night had rendered the rails so excessively slippery, that, on descending the incline, all his attempts to stop were unavailing, although he put on his breaks, and even reversed the engine. This, on what authority we know not, has been contradicted, so as to make it a case of sheer negligence; and, indeed, our own experiences do not admit of a belief that, if proper care had been taken, a stoppage might not have been effected, if not without inconvenience, at least without a collision. It has also been stated that the driver was inexperienced, having been a fireman, promoted from the Maryport line.

Atmospheric Railway Schemes:—Fell's Motive Power Company—Bragg's Atmospheric Railway.—We had thought that the atmospheric system had long ere this received a finishing blow; but our attention having been drawn to two new schemes, we find that we anticipated wrongly. The first of the two plans in question has originated with a Mr. Richard Fell, whose circulars speak largely of a working company with a capital of £150,000. From what we can make out of the details of the invention, as supplied to us, it would appear to amount to a species of compromise between the locomotive and stationary atmospheric systems. Between the two rail-tracks of a double line, a continuous cast-iron pipe is laid, and at every 22 feet transverse branches, acting as air-vessels, pass from it to the centre of each line. These branches terminate in valve faces, over which works a kind of long travelling slide-valve, carried by the traction truck. This slide-valve communicates with a cylinder bolted to the frame of the truck, to which latter the cylinder gives motion, by means of a piston and connecting rod, attached to a driving wheel, as in the locomotive. The continuous pipe is kept filled with compressed air by a stationary engine, so that each of the transverse vessels is constantly full. The feed-pipe from each air-vessel conveys the air to the travelling slide-valve; and on this pipe is an air-cock, to be acted on by a lever bar of the same length as the slide-valve, the use of which is to open the air-cock, and keep it open until the valve has passed from one vessel to the other. The valve is 22 feet long, being equal to the distance passed over by one stroke of the cylinder, and contains a number of small valves, placed from one end to the other, so that the first valve shall be over the feed-pipe of the next air-vessel, as the last one clears the one behind. A chamber covers the whole length of these valves, the connection with the receiver supplying the cylinders being by a flexible tube. It will be seen from this, that the tractive power arises from the pressure of the compressed air in the receivers acting upon the pistons of the cylinders on the foremost truck, which pistons work a pair of driving-wheels in the ordinary way. The plan bears a strong resemblance to one already patented twice, by Mr. Bovill of London, and Mr. Nairne of Milnhaugh, Perthshire. In both these schemes, the driving cylinders were stationary, and set at intervals along the line. They were worked by a continuous air-pipe, and gave motion to the train by a couple of horizontal friction wheels, working one on each side of a strip of timber fast to the bottom of the carriages. It is difficult to see what is proposed to be gained by the adoption of any of these contrivances.—The other invention noted at the head of this article, has been patented by Mr. Bragg of Pentonville, London. A series of cylinders of 9 inch bore, and 25 feet long, are laid down between the rails—not continuously, but in what may be termed a series of steps. Thus the first cylinder is placed near one side of the enclosed rail-track; the second in the middle; and the third on the opposite side. All these divisions are closed at each end, and the piston of each has a rod projecting through a stuffing-box in each end cover. They are also all connected with continuous exhaustion tubes laid down one on each side of the line. A rack-bar extends the whole length of the piston rods outside the cylinders, and whilst no train is passing, the rack and piston rod are locked. When the exhaustion is formed, a catch on the frame of the first carriage of the train unlocks the rack, and into this a detent gears at the same moment that another detent opens a valve at the end of the cylinder, admitting the air behind the piston, which carries with it the train for 25 feet, until the next cylinder comes into action, and carries it the same distance. This scheme, together with those previously enumerated, may certainly claim a place in our catalogue of the "curiosities of invention."

ENGLISH PATENTS.

Sealed from 27th September, 1849, to 18th October, 1849.

John Meadows, Princes-street, Coventry-street, Middlesex, carver and gilder—"Improvements in veneering."—September 27.

John Marriott Blashfield, Mill-wall, Poplar, Middlesex, Roman cement manufacturer,—"Improvements in the manufacture of manure."—27th.

William Browne, St. Anstell, Cornwall, mine agent, and Richard Rowe Veale, St. Columb Major, in the said county, gentleman,—"Improvements in preparing for pulverization flint stone, China stone, ores, minerals, spars, sands, earths, and other substances."—27th.

Nicholas Dorrau Maillard, Edward-street, Portland-place, engineer,—"Improvements in obtaining motive power for giving motion to machinery, and in propelling vessels." 27th.

William Boggett, St. Martin's-lane, Middlesex, gentleman,—"Improvements in heating and evaporating fluids."—27th.

William Edward Newton, 66, Chancery-lane, civil engineer,—"Improvements in the manufacture of knobs for doors, articles of furniture, or other purposes, and in connecting metallic attachments to articles made of glass or other analogous materials."—(Being a communication.)—27th.

James Higgins, Salford, machine-maker, and Thomas Schofield Whitworth, Salford, mechanic,—"Certain improvements in machinery for preparing, spinning, and doubling cotton, wool, flax, silk, and similar fibrous materials."—24th.

The above patent, being opposed by caveat at the Great Seal, was not sealed till 2d October, but bears date the 24th September, the day it would have been sealed had no opposition been entered.

William Jamieson, Ashton-under-Lyne, machine-maker,—"Certain improvements in looms for weaving."—October 4th.

Charles Attwood, Tow-law Iron Works, near Darlington, Durham, Esq.,—"An improvement or improvements in the manufacture of iron."—5th.

William Edward Newton, Chancery-lane, civil engineer,—"Improvements in machinery for planing, tongueing, and grooving boards or planks."—(Being a communication.) —5th.

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* Farbenchemie. 2 vols. Berlin, 1832 and 1845.

Alfred Vincent Newton, Chancery-lane, mechanical draughtsman,—" Improvements in the manufacture of pipes or tubes."—(Being a communication.)—5th.

Henry Watson, Newcastle-upon-Tyne, brassfounder,—" Improvements in valves and cocks."—12th.

Robert Larkin, Ardwick, Lancaster, machinist, and William Henry Rhodes, Openshaw, Lancaster, mechanic,—"Certain improvements in machinery, and for preparing, spinning, doubling, and weaving cotton and other fibrous substances."—12th.

Peter Armand le Comte de Fontainemoreau, of South-street, Finsbury,—" Improvements in spinning fibrous substances."—(Being a communication.)—12th.

Joseph Lowe, Salford, Lancaster, surveyor,—" Certain improvements in grates or grids applicable to sewers, drains, and other similar purposes."—12th.

Michael Titch, Chelmsford, Essex, patent salt manufacturer,—" Improvements in baking bread, biscuits, and other matters, which improvements are applicable for drying goods."—12th.

Cornelius Bonell, Kempsey, Worcester, engineer,—" Certain improvements in rotary engines to be worked by steam or other means, and also in the construction of carriages, vessels, or other vehicles to be worked or propelled by the said improvements in rotary engines or other motive power, and for the machinery to be connected therewith."—12th.

James Banister, Birmingham, manufacturer,—" A certain improvement or certain improvements in tubes for locomotive and other boilers."—12th.

George Alois Ringeison, Essex-street, Strand, Middlesex, chemist,—" A composition or preparation for destroying vermin."—12th.

Charles Rowley, Newhall-street, Birmingham, button manufacturer,—" Certain improvements in apparatus for weaving, and in articles to be attached to dresses."—12th.

John Bury, Torkington, Lancaster, railway contractor,—" Certain improvements in the construction of chairs for railways."—12th.

John Christophers, Heavitree, Devon, formerly merchant and shipowner,—" Improvements in naval architecture."—12th.

Thomas Lightfoot, Broad Oak, Lancaster, chemist,—" Improvements in printing cotton fabrics."—12th.

William Stedman Gillett, Wilton-street, Grosvenor-place, Esq.,—" Improvements in packing pistons, stuffing-boxes, slides, and other parts of machinery, and in forming bearings, and in making cylinders and other forms of metal."—12th.

Conrad William Finzel, Bristol, sugar-refiner,—" Improvements in the processes and machinery employed in and applicable to the manufacture of sugar."—12th.

John Mercer, Oakenham, Lancaster, gentleman, and William Blythe, Holland Bank, in the same county, manufacturing chemist,—" Improvements in certain materials to be used in the process of dyeing and printing."—12th.

Jules le Bastier, Paris, gentleman,—"Certain improvements in machinery or apparatus for printing."—12th.

Joseph Johnson, Huddersfield, York, bricklayer, and Joe Cliffe, of the same place, ironfounder,—" Improvements in furnaces, or in the means of consuming smoke."—12th.

John Debell Tuckett, Plymouth, Devon, merchant,—" A new and improved method of preparing a manure called superphosphate of lime, without using any acids in the decomposition of the various substances of which manures now in use are made, and for which patents have been obtained, called superphosphate of lime, by the application of artificial agency, by which more than double the quantity of a true superphosphate of lime can be produced beyond that for which any patent has hitherto been granted, that the same may be applied in the production of all kinds of crops, more particularly wheat, barley, oats, turnips, and other vegetables."—18th.

Thomas Dawson, Melton-street, Euston-square, machinist,—" Improvements in cutting and shaping garments and other articles of dress for the human body."—18th.

George Shove, Deptford, Kent,—" Improvements in manufacturing ornamented surfaces when glass and other substances are used."—(Communication.)—18th.

Joseph Stovel, Suffolk-place, Pall-Mall East, Middlesex, tailor,—" Improvements in coats, part of which improvements are applicable to sleeves of other garments."—18th.

David Hulett, Holborn, Middlesex, gas engineer, and John Birch Paddon, Lambeth, gas engineer,—" Improvements in gas meters and in gas regulators."—18th.

Ethan Campbell, New York, philosophical, practical, and experimental engineer and artisan, United States,—" Certain new and useful improvements in the means of generating and applying motive power, and in propelling vessels."—18th.

William Wyatt, Waterloo-cottage, Oldswinford, Worcestershire, pump-maker,—" Improvements in coating the surfaces of pumps, pipes, cisterns, and other articles of iron." —18th.

Charles Felton Kirkman, Argyle-street, Middlesex,—" Certain improvements in machinery for spinning or twisting cotton, wool, or other fibrous substances."—18th.

William Henry Balmain and Edward Andrew Parnell, St. Helen's, Lancashire, manufacturing chemists,—" Improvements in the manufacture of glass, and in the preparation of certain materials to be used therein, parts of which improvements are also applicable to the manufacture of alkalies."—March 5th, 1849.*

* By some mischance, this patent did not appear in its proper place in our April Part.

IRISH PATENTS.

Sealed from 21*st September*, 1849, *to* 20*th October*, 1849.

James Warren, Montague Terrace, Mile-End Road, Middlesex, gentleman, and Willoughby Theobald Monzani, Saint James's Terrace, Bermondsey, Surrey, gentleman,— " Improvements in the construction of bridges, viaducts, and aqueducts, and in anchors, and in drilling and boring braces."—September 27th.

Robert Plummer, Newcastle-on-Tyne, manufacturer,—" Certain improvements in machinery, instruments, and processes employed in the preparation and manufacture of flax and other fibrous materials."—October 1st.

John Holland, Larkhall Rise, Clapham, Surrey, gentleman,—" A new mode of making steel."—(Communication.)—6th.

SCOTCH PATENTS.

Sealed from 22*d September*, 1849, *to* 22*d October*, 1849.

John Mason, Rochdale, Lancaster, machine-maker, and George Collier, Barnsley, York, manager,—" Certain improvements in machinery, or apparatus for preparing and spinning cotton, and other fibrous materials, and also improvements in the preparation of yarns or threads, and in the machinery or apparatus for weaving the same."—September 24th.

William Parkinson, Cottage-lane, City-road, Middlesex, successor to the late Samuel Crossley,—" Improvements in gas and water meters, and in instruments for regulating the flow of liquids."—24th.

James Aitken, Cook-street, Glasgow, North Britain, manufacturer,—" Certain improvements in the preparation of cotton and other yarns for weaving, and in the machinery employed therein."—27th.

John Robinson, Patterson-street, Stepney, Middlesex, engineer,—" Improvements in machinery for moving and raising weights."—October 3d.

Ernst Grapel, Birmingham, Warwick, Esq.,—" Improvements in marine vessels, in apparatus for the preservation of human life, and in moulding, forming, and finishing hollow and solid figures, composed wholly or in part of certain gum, or combination of certain gums; also, improvements in dissolving the aforesaid gums, and in apparatus or machinery to be used for the purposes above-mentioned."—8th.

Robert Clegg, Joseph Henderson, and James Calvert, Blackburn, Lancaster, manufacturers,—" Improvements in looms for weaving."—8th.

Thomas Lightfoot, Broad Oak, within Accrington, Lancaster, chemist,—" Improvement in printing cotton fabrics."—11th.

William Gaspard Brandt, 16 Compton Street, Brunswick-square, Middlesex,—" Improvements in the construction of the bearings of railway engines and railway and other carriages now in use."—11th.

George Henry Dodge, citizen of the United States of America, but now residing at Manchester, Lancaster,—" Certain improvements in machinery for spinning and doubling cotton, yarns, and other fibrous materials, and machinery or apparatus for winding, reeling, balling, and spooling such substances when spun."—15th.

Charles Shepherd, and Charles Shepherd, junior, both of Leadenhall-street, London, chronometer makers,—" Certain improvements in working clocks, and other time-keepers, telegraphs, and machinery, by electricity."—15th.

Thomas Beale Browne, Hampden, Gloucester, gentleman,—" Certain improvements in looms, and in the manufacture of woven and twisted fabrics."—15th.

David Christie, St. John's-place, Broughton-lane, Salford, Lancaster, merchant,— " Welding and uniting cast-iron with steel and malleable iron."—(Being a communication.)—19th.

George Park Macindoe, Mountblow, Old Kilpatrick, Dumbarton,—" Certain improvements in machinery or apparatus applicable to the preparation, spinning, and doubling or twisting of cotton, wool, silk, flax, and other fibrous substances."—19th.

Joseph Stovel, Suffolk-place, Pall-Mall East, Middlesex, tailor,—" Improvements in coats, parts of which improvements are applicable to sleeves of other garments."—19th.

Frederick William Norton, Lascelles-hall, Lepton, Kirkeaton, York, fancy cloth manufacturer,—" Improvements in manufacturing plain and figured fabrics."—19th.

John Combe, Leeds, York, civil engineer,—" Improvements in machinery for heckling, carding, winding, dressing, and weaving flax, cotton, silk, and other fibrous substances." —22d.

DESIGNS FOR ARTICLES OF UTILITY.

Registered from 22*d September*, 1849, *to* 18*th October*, 1849.

Sept. 22d,	No. 2038.	John Sanders and Samuel Rooke, jun., Birmingham,—" A set of dies for forming hollow or tubular rings."
—	2039.	Charles Edward Butler, Farringdon-street,—" Hearse."
26th,	2040.	William Wilson, Manchester,—" Gas retort."
Oct. 1st,	2041.	John Gray, Edinburgh,—" Gravy dish."
—	2042.	William Frederick Padwick, Southampton,—" Garden drill."
—	2043.	Gray and Keen, Liverpool,—" Aural log timer."
—	2044.	John Benjamin Winder, Birmingham,—" Envelope."
3d,	2045.	Josiah Human, C.E., March, Cambridgeshire,—" Water elevator."
4th,	2046.	John Morland & Son, Eastcheap,—" Floriform parasol."
5th,	2047.	Walter Morgan, Liverpool,—" Wire-fastened circular brush for cleaning boilers and other tubes."
—	2048.	Isaac Green, Victoria-place, Euston-square,—" Wind guard."
6th,	2049.	George Alexander Copeland, Pendennis Castle, Falmouth,—" Safety cartridge for blasting purposes, in mines, quarries, and other situations."
8th,	2050.	John Hynam, Princes-square, Finsbury,—" Metal box with rounded corners at ends and bottom, to be opened by a horizontal groove slide (inverted).
—	2051.	William Gray, Charles Christopher, and Thomas Barratt, Liverpool,—" Cooking apparatus for ships."
—	2052.	James Townsend, Birmingham,—" Improvements on or addition to valves for air-guns."
10th,	2053.	W. Thicthener, Union-terrace, Bagnigge-wells-road,—" Solid impulse lever."
13th,	2054.	William Tranter, Birmingham,—" Lever catch for pistol locks."
—	2055.	A. Beldham and Co., Portsea,—" The Roman toga."
15th,	2056.	Oliver and Co., Regent Street,—" Graduated plug flower-pot."
—	2057.	Edw. Burgess and Thomas Hewetson, Clerkenwell-green, Robert-street, Bedford-row,—" Thermomotive spring."
16th,	2058.	Brown, Lennox, and Co., Billiter-square and Millwall,—" Instrument for retaining the links of a flat chain in position."
17th,	2059.	Charles Minifie, Bristol,—" Shirt."
—	2060.	Charles C. B. Williams and Co., Old Montague-street, Whitechapel, —" The family safeguard match-box."

TO READERS AND CORRESPONDENTS.

J. S. S.—We had hoped ere now to have furnished him with the necessary details of the new beams; but our own information about the plan is so far unsatisfactory.

B. S., Haworth.—His notes are very acceptable. We shall find room for them next month.

E. Hunt.—His data are insufficient. How are we to draw an ellipse without knowing its transverse, as well as its conjugate radius? The one has nothing to do with the other; and with a given conjugate diameter we may make the transverse one any length we please. See our article, " Illustrations of Mechanical Drawing," written for the " Practical Mechanic and Engineers' Magazine" for March, 1846, p. 158.

" Jacid."—We have received his valuable letter on " Decimal Currency," the gist of the remarks in which may probably serve a useful purpose hereafter. Our opinion on the "florin" has been questioned; therefore we are glad to find he agrees with us as to its comparative uselessness.

C. Dunlop.—We have received his polite communication. His remarks will be put to use next month.

G. Tosh, Whitehaven.—We lately saw, at the Birmingham Exposition, gutta percha driving belts, fitted with both an inner and outer covering of leather. He will see from this, that, although the idea may be original to him, yet it is not new. We shall, however, draw attention to the subject, in connection with his remarks, next month.

J. K., Dumfries.—In either case, we shall have much pleasure in hearing from him, and space will be found for the design.

T. P., Boston, U.S.—We addressed a letter to him as desired, per mail of the 19th ult. His favours will be very acceptable.

Messrs. Morland.—If it can be forwarded some little time previous to its public appearance, it will be available.

S. L., Edinburgh.—The published account amounts, in fact, to no information. When he can supply further details, will he communicate with us?

C. C.—We saw the engine he mentions shortly after it was erected. In our opinion its expansive arrangement does not present any theoretical advantages over many other plans which we could name, and, practically, it is complex, inconvenient, costly, and, we are afraid, liable to give trouble in keeping in order. If he thinks otherwise, we shall be glad to have his reasons.

THE NATIONAL EXPOSITION OF WORKS OF INDUSTRY IN 1851.

The proposition that has emanated from His Royal Highness Prince Albert, to form a grand exhibition of the industry of all nations, to be held in London in the year 1851, is now a matter of the greatest interest to all classes, but more especially so to the merchants and manufacturers of the kingdom. When we say the kingdom, we may be deemed to use too exclusive a term, as the exhibition is intended to be for the display of the industry of all nations; and the magnitude of the intended prizes insures the purpose of the exhibition being fully carried out.

Meetings have been held in all the principal towns in the kingdom; and the feeling at those meetings has been universally in favour of the intended exhibition, although, of course, there has been considerable difference in opinion as to the most suitable means of effecting the proposition.

A meeting was held in London on the 17th of October last, convened by the Lord Mayor, for the purpose of receiving a deputation from the Society of Arts, commissioned by their President, Prince Albert, to explain the outlines of the intended exhibition. At this meeting—the proceedings being, of course, merely preliminary—it was stated, that the subject had been under the consideration of the Society of Arts for the last five years; but that the entire success of the exhibition of the Society of Arts, held this year, had encouraged Prince Albert to mature his plans for the formation of the exhibition now contemplated, and which is intended to be on a scale of so much more importance.

His Royal Highness appears to have taken a great personal interest in the matter, apart from his position as President of the Society of Arts; and it is a matter of congratulation to our fellow-countrymen, that one in so exalted a position should invariably have testified so great an interest in the advancement of the arts and manufactures of this country.

It was long a question whether the subjects of the exhibition should be exclusively limited to the products of British industry; but it was considered, in the words of the Prince himself, that "Whilst it appears to be an error to fix any limitation to the productions of machinery, science, and taste, which are of no country, but belong, as a whole, to the civilized world, particular advantages to British industry might be derived from placing it in fair competition with that of other nations." We are glad to observe that the feeling on this head has been so entirely unanimous—out of 600 or 700 gentlemen who have been consulted upon the subject, only one, in the first instance, expressed a contrary opinion, and he, in the course of a few weeks, completely altered his views. We think that our manufacturers have no need to fear the rivalry of foreigners; and that it will most materially conduce to the interest of the exhibition to have the opportunity afforded of comparing the productions of our own manufactories with those of the rest of the world.

It will be a great advantage to us to inspect some of the tasteful designs in which they surpass us; and by the opportunity to be afforded, we hope our manufacturers will profit, not by the mere copying the objects placed before them, but that by contrasting the designs, in which so much elegance and taste is exhibited, with the clumsier productions of our own workshops, they may be imbued with a spirit of fair rivalry, which will, we hope, leave lasting results.

The principal manufacturers of the kingdom, who have been consulted, seem entirely to agree that the Exposition should be international, although, of course, they are aware that upon some points they cannot expect successfully to compete with foreigners. We are glad to find this feeling so universal, and perfectly agree with some of the Lancashire men that have been consulted, that a fair field and no favour is all that we require.

The subjects of the exhibition are proposed to be divided into four divisions—viz., raw material, machinery and mechanical inventions, manufactures, sculpture, and plastic art generally. These will, doubtless, be each of the very highest class; and we are told we may expect "raw materials from all quarters of the globe; specimens of animal and vegetable life, as well as of minerals—samples of what is in the earth, and what is produced upon it; enormous elephants' tusks from Africa and Asia; leather from Morocco and Russia; beaver from Baffin's Bay; wools of Australia, of Yorkshire, and of Thibet; silks of Asia and Europe; and furs from the Esquimaux." The East India Company intend to produce the best and most magnificent productions of their possessions. The Australian and other public companies will vie with them and each other in this laudable object. We are to have cotton from Asia, to compare with that from America; corn from Connemara, with the corn of England and the shores of the Baltic; spices from the East, the hops of Kent and Sussex, the raisins of Malaga, and the olives of the Pyrenees. Of mineral productions, we may expect to see gold from California and the East Indies; silver from Mexico, Russia, and Cornwall; iron from Scotland, Wales, Wolverhampton, and Tunbridge Wells. We shall also have clays from Bideford, Truro, and Putney. In machinery we may hope to see, perhaps, the most magnificent part of the Exposition. To enter into detail upon this head would be utterly ridiculous; it is sufficient, that our greatest engineers have promised to do their best. In this, as in other branches, we shall have specimens of everything, from the highest to the lowest; and it is this that will render the exhibition of so peculiarly interesting a character, not only to the man of science, but to the whole community.

In the exhibition of plastic art and sculpture, comprising all that relates to building and architectural art, we are afraid our home productions can scarcely be expected to equal those of our continental neighbours; and, in this department, we hope we shall be favoured with the very best efforts of the continent, for the benefit of those amongst us who have not the opportunity or the means to visit them in their own manufactories.

The question, where the site for this gigantic undertaking was to be found, is one which seems to have perplexed the promoters considerably. The government offered the area of Somerset House; but this, we think, for several reasons, is scarcely desirable. The Prince proposes the vacant ground on the south side of Hyde Park, parallel with and between the Kensington Drive and Rotten Row. This seems, in all respects, to be a most desirable position, and, from the facility of access to it, will suit all classes. It is as easily attainable by an omnibus as by a private carriage. The Commissioners of Woods and Forests would, no doubt, allow the ground to be used for the purpose, and it would interfere less with business arrangements, than if held in such a situation as the area of Somerset House, as was once proposed.

To induce the whole world to enter into the pacific competition proposed, it is thought necessary to offer very large prizes; and it has been, therefore, determined that £20,000 worth of prizes, at least, shall be offered on the occasion. The means by which this sum is to be raised do not very clearly appear. That there will be no difficulty in raising, by voluntary contributions, the amount required, we do not doubt; and we think that mode of raising the sum required will, on the whole, give more satisfaction to the public, than if the amount was to be raised by compulsory taxation. Several opinions have been given upon this point by gentlemen interested in the matter; but the conclusion arrived at seems to have been an almost universal feeling that the contributions should be voluntary. In other countries the several exhibitions of this kind have been supported by government funds; and this has been urged by some parties as a reason why the proposed exhibition should also be at the government expense; but we are convinced it is more to the interest of the country at large that the subscriptions should be voluntary.

An eminent manufacturer of Paisley remarks—"That as this is a great national work, intended for a great national benefit, its stability, as well as the confidence of the public, will be greatly secured by government bearing a moiety of the expense." We must dissent from this view of the case, and express our entire concurrence with the feeling of Prince Albert and the Society of Arts, that it would be far nobler for the English people to do the thing well for themselves, than to ask for the assistance of government. We cannot doubt that funds most ample for the occasion will be readily contributed by the English people for this most desirable object; and that they will take a much deeper interest in the exhibition, when supported by themselves voluntarily, than they would have done had the funds to be supplied by government, when it would, no doubt, have been looked upon as a species of compulsory taxation, and in that light viewed much less favourably.

It has been determined that, the funds having been obtained, government shall be asked to appoint a special commission for the purpose of distributing the prizes; and in this is the most delicate part of the arrangement—upon the distribution of these prizes depends, in a great measure, the fate of the exhibition. If, in their distribution, there shall appear anything like partiality—any jobbing, with which, as a nation, we have been so much reproached in our national undertakings, more especially buildings—or, if there shall appear any incompetency upon the part of the judges to determine the proper appropriation of the immense prizes to be given—then, instead of the magnificent undertaking we expect, the whole affair will be turned into ridicule, and we shall at once see the first and the last exhibition of the Industry of all Nations. For the honour of the country, we trust that nothing of this kind may take place; but that, by a judicious selection of men of the first standing, and of the very nicest honour—and that there are no lack of such men we may safely assert—the exhibition may be a subject of national pride, and may be the commencement of a series, which will do much to advance the interests of British manufacturers and merchants, and, with them, the well-being of the mass of mankind.

As a nation, we have within us the best and most extensive mine of materials for such an exhibition in the world. The question to be asked is, at any rate, not one of supply—that has long ago been settled—but the plan of procedure; the system of collection and arrangement; in short, the most judicious mode of turning our resources to account alone claims our attention. The names of the gentlemen connected with the Society of Arts, and others, who have lent their aid in the preliminary metropolitan meetings, are a tolerable guarantee for the efficient establishment of the affair, as far as they are connected with it; but a vast amount must necessarily depend upon the local labourers, and in their selection and organization the greatest care must be observed. The most able men must be chosen as the representatives of the several leading industrial branches—as agriculture, manufactures, engineering and mechanism, and ornamental art. Here, again, the difficulty is merely one of selection, which care and due tact will remove.

In glancing over the evidence and opinions picked up in the various quarters in which the projectors have directed their inquiries, it is most gratifying to find such a general unanimity of feeling on the subject, as, although a variety of suggestions have been offered, all appear impressed with the desirableness of testing, in this magnificent manner, the comparative excellence of the works, not merely of rival neighbours, but of industrially contending nations. Time was, indeed, when one manufacturer trembled at the idea of another's obtaining the least insight into his workshop; and, even now, we here and there meet with instances of narrowmindedness on this score, which time and social intercourse is only very slowly removing. Look at France, where this petty jealousy has been drowned by the better feeling which has prompted each man to pit his work against his neighbour's, and compare for a moment the present state of its splendid art productions with that drowsy "it's well enough" sort of condition, inseparable from a system where an honourable emulation is virtually shut out. Originating in a suggestion made by a single individual, an inspector of the government china manufactory at Sevres, who, in 1798, personally collected a few examples of the leading productions of the country, the idea has gradually expanded; and we all know to what it has now been carried, as exemplified in the exposition of the present year.

The accompanying illustrative table of eleven consecutive expositions explains more graphically than any mere statement can do, the rapidity of the extension of the system:—

Exposition.	Year.	Days open.	Place where held.	Number of contributors.	Rewards.
1	1798	3	Champ de Mars	110	23
2	1801	6	Louvre	229	80
3	1802	7	Louvre	540	234
4	1806	24	Esplanade de Invalids	1422	610
5	1819	33	Louvre	1662	869
6	1823	50	Louvre	1642	1091
7	1827	62	Louvre	1693	1234
8	1834	60	Place la Concorde	2447	1785
9	1839	60	Champs Elysees	3281	2303
10	1844	60	Champs Elysees	3960	3253
11	1849	—	Champs Elysees	4494	——

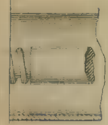
The building of the present year covers an area of 800 feet by 270 feet, an open space being left in the centre for a fountain, reservoir, and horticultural collection. With this exception, the whole space is covered with manufactured articles in endless variety, and the visitor is guided in his inspection of them by some three miles of labyrinthic walks. In the collection of the articles, the prefect of a central jury nominates a commission in each of the contributing districts, and this body determines upon the eligibility, or otherwise, of the tendered articles. As this arrangement will undoubtedly be followed out in our own case, it may not be uninstructive to note the good sense characterising the selection of men, who, in their body, show a happy mixture of artists, philosophers, and manufacturing producers. Thus, we find Arago, Dupin, Chevreul of the Gobelins tapestry works, Laborde, the Eastern traveller, Bougon, the director of the Chantilly porcelain manufactory, and Leon Fauchere, the architect, combined to render assistance on the central jury. We may, perhaps, be taxed with making too long a digression from our subject, in referring even thus casually to the continental project; but our object being to cast our mite into the treasury of hints for the approaching display, it is presumed that our notes on the French plans may not be wholly without value.

So far, we believe, nothing definite has been fixed; but the local committees will shortly be organized, and we may then reasonably hope to see a combined movement in action. At the present stage, it would be idle to speculate upon probabilities; but the anticipated grandeur of the collection may be gathered from the fact of a building a mile and a half in length being openly hinted at, and £100,000 as the sum likely to be expended in this way, is freely canvassed. To give some weight to the prize list, it is to be headed with one of £2,000, and four of £1,000—one in each of the grand sections; and in further imitation of our French precedents, the exhibition is proposed to be quinquennial. Let us then now prepare for the coming struggle; and, to avoid the too fatal results of procrastination, let each candidate for eminence in his art—and we hope all our countrymen will prove themselves to be of this class—now take time by the forelock, and resolve to do his best, and that right early. We know pretty well what we have to expect as examples of foreign works. We know that from America we shall have a host of devices, startling from their very boldness; from France will come a display of unrivalled novelty, delicacy, and elegance of taste; whilst our home producers will find each one putting forth his strength in examples of that mechanical ingenuity and exactitude of action, which have always been the envy and the admiration of the world.

Glasgow is, for many reasons, in an excellent position for furnishing forth a brilliant array of contributions. From her works in cotton-spinning, weaving, calico and muslin-printing, engraving, engineering, me-

ENGINE.

Vol. II



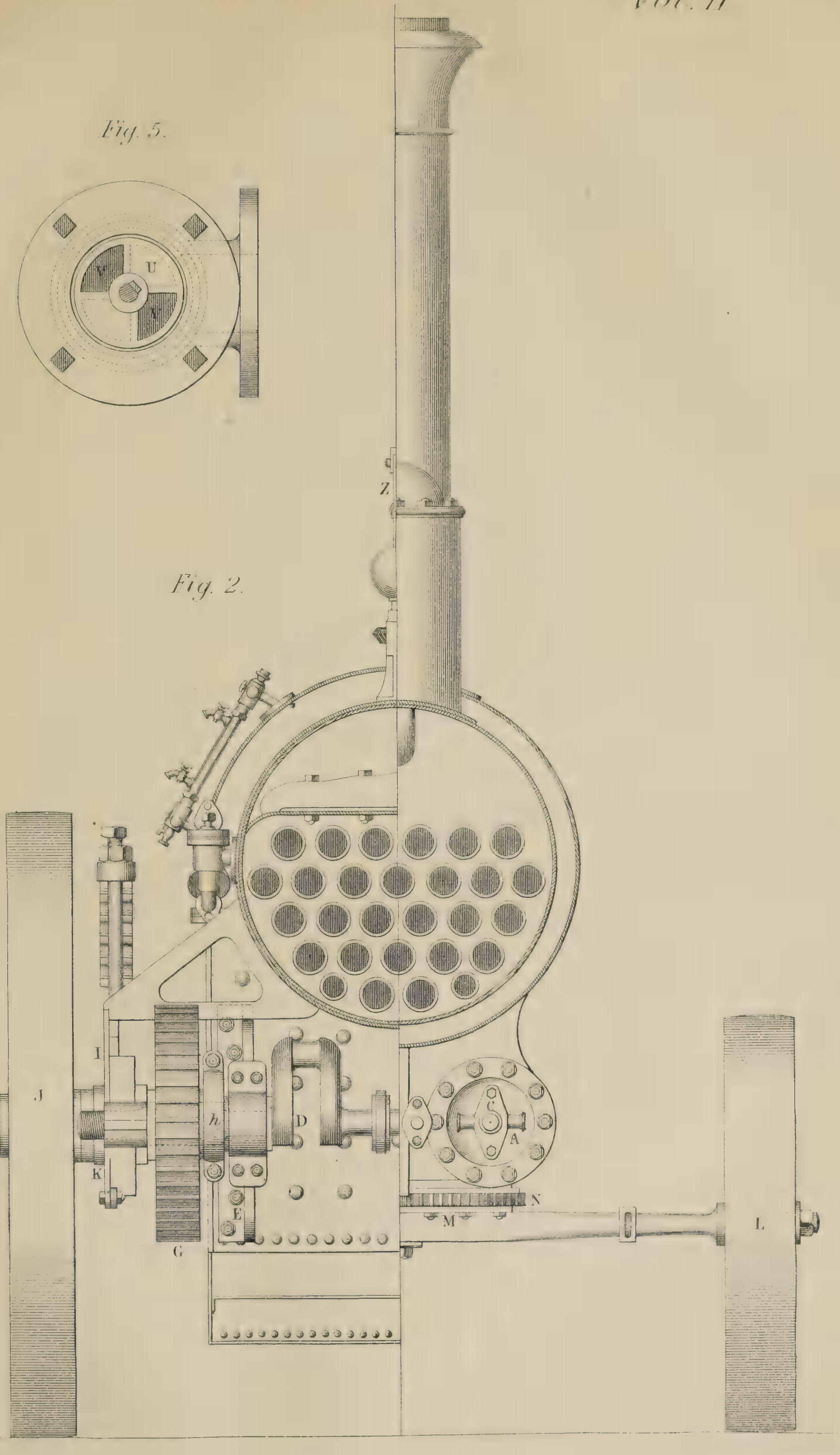
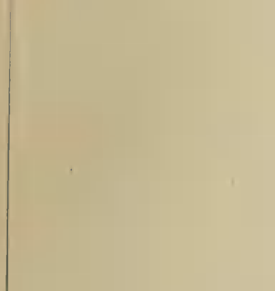


Fig. 5.

Fig. 2.



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WILLIS' FARMER'S STEAM ENGINE.

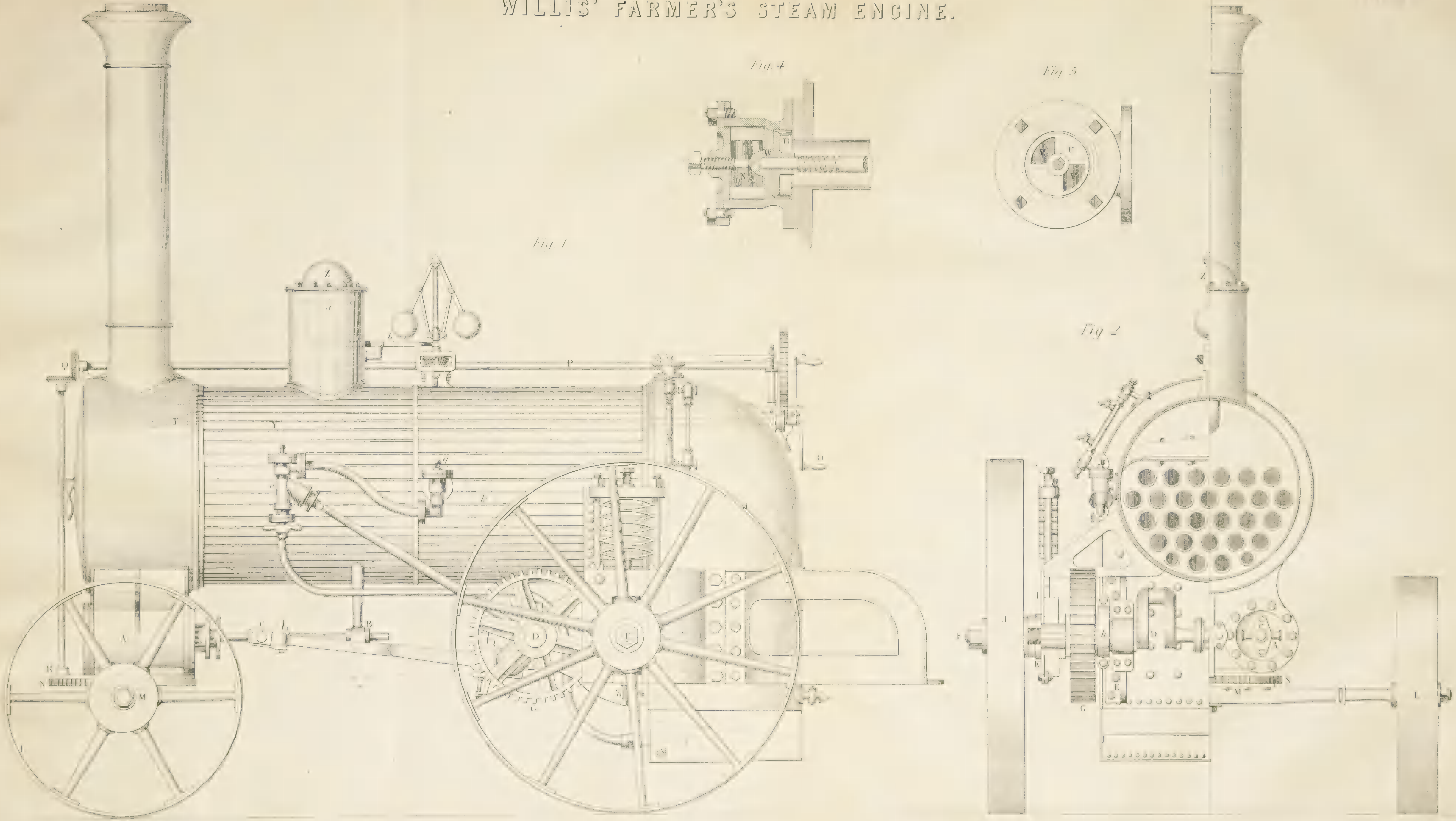

Fig 1

Fig 2

Fig 4

Fig 5

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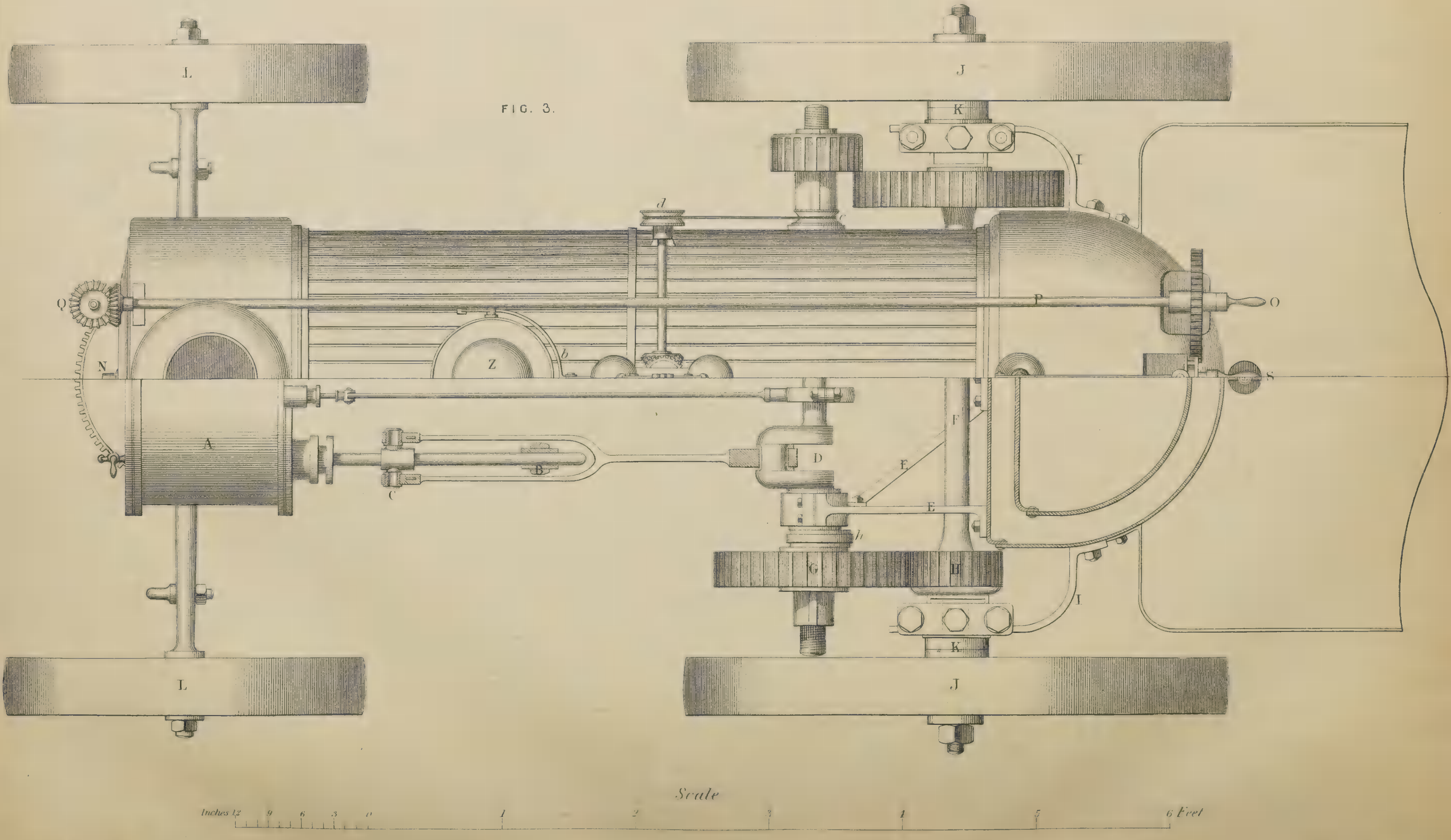
Scale

Inches 12 9 6 3 0 1 2 3 4 5 6 7 Feet

WILLIS' FARMER'S ENGINE.

FIG. 3.



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Geo. Aikman sc. Edin.

chanism and ship-building, glass-making, metal-founding, dyeing, and paper-making, we may look for much that is excellent from her best artizans, and, through them, for a spurring incentive to do better, on that of her second-rate ones. And, taking the wider field of Scotland's seats of production and constructive art, we may expect to see from Paisley, her perfections in shawls, sewing-thread, and carpets; from Ayrshire, her finest embroidery; and, from Dundee, her flax manufactures; whilst the whole country will pour forth a fair earnest of its mineral treasures.

As expressed by one of our eminent manufacturing neighbours, if we wish to prevent home purchasers from laying out their gold abroad, we must practically assert our own superiority of production at home. In many departments, at present sadly misunderstood in this way, we shall be well able to do this; in others we shall fail. But to our foreknowledge of the high rank of the French as decorators and artificers, in the bulk of the lighter requirements of civilized life, we have the consolation of adding that of their vast inferiority in points which appertain to what an Englishman calls "good work." In this immense industrial rivalry, then, we are not to rest satisfied with those efforts which have, in some branches, placed us in the enviable position of the first rank; but in the comparison with antagonistic imitations, which must surely and constantly approach towards us if we stand still, we must, with a fixed resolve, lay our account with yet further struggles towards perfection. In the few points where our best attempts will be dimmed before the brighter glare of competing excellence, we must be content to show ourselves worthy followers of the best preceptors; thus, by giving and taking, we may benefit ourselves, and be, in some degree at least, instrumental in the diffusion of the mass of the world's improvement.

THE MECHANISM OF AGRICULTURE.

WILLIS'S FARMER'S STEAM-ENGINE.

(*Illustrated by Plates* 38 *and* 39.)

At a recent agricultural meeting in the north of England, the leading speaker, who has earned for himself the designation of "a certain noble and learned lord"—albeit, being a lord, our readers will easily comprehend who we mean—advanced strong reasons for an improvement in the mechanical department of agriculture, and the more general use of the steam-engine for farm purposes. The remarks in question, although highly tinctured with that peculiar eccentricity, which is continually prompting the author of them to hazard his opinions on all and every subject coming before him, whether his information on it is up to the mark or not, are well worth the attention of the farmer and agricultural implement maker, if simply for the purpose of directing their consideration to the hitherto wofully neglected department of agricultural engineering. To this end, we will extract so much of his address as will supply a suitable illustration of his views on the insisted points. He said—

> "I adverted on a former occasion to the application of steam to agricultural purposes. I find that attempts are about to be made in that direction, and that we may shortly look for the application of steam to ordinary farming operations. I think that is of the highest possible concernment; and I have no doubt whatever that before twelve months pass over we shall see attempts made—they may fail at first, as the steam-engine itself failed at first, but which must afterwards succeed—to apply steam upon a limited and compendious scale. What I desire is, to see steam-engines, not too large, not too expensive in point of fuel, but somewhat between the large sort and the common tea-kettle, such as are stated to have been used at Glasgow in the preparation of the smallest manufactures. This I should wish to see applied not merely to thrashing machines, or sifting and chopping machines in the house, or under cover, but in the field; I expect to see steam operations in the field itself. And if any one says that this is a chimerical and visionary expectation, how long, I would ask, is it since he would have accounted it a visionary speculation to see carriages drawn by steam? Yet they are now supplanting horses, and carriages of every other description; and I confess I expect to see steam, if not supplanting, at all events aiding, the horse and ploughman in the field. To take only one instance. There can be no doubt that clod-crushing is a most important operation, and it is a subject that I forgot to mention the other day. I must again confess that I am perfectly ignorant upon the practice of agriculture—I confess it now, and I always said so—but upon this subject I may be allowed to observe, that I have contributed not a little to the advancement of agricultural improvement, as I have the honour of being the president of the society well known as the "Useful Knowledge Society," and we have published eight volumes on agricultural subjects with reference to horses, cattle, manure, &c., in very cheap numbers, under that presidency. Lord Althorp, afterwards Earl Spencer, but unfortunately now no more, when vice-president of the society, attended more to those topics than I did; nevertheless, I also paid some attention to them, and having lately refreshed my memory by some of the disquisitions in those works, I find the important subject of clod-crushing largely treated of there, and there are three or four different kinds of machines for that purpose, to one or two of which steam is obviously applicable."

Thus, despite his admitted ignorance of the practice of agriculture, he has judged, and rightly, that he knew at least enough to satisfy himself of the vast benefits likely to accrue from the introduction of that most powerful of man's assistants in the task of conquering matter—the steam-engine—to the fields and farmyards of the practical tiller of the soil. Why, indeed, is it—when all nations acknowledge with admiration the high pitch to which we have carried our practice of mechanics in every pursuit, essentially denominated a manufacture—why is it, we ask, that the mainspring of all manufactures, the culture of the earth, has hardly yet felt any direct benefit from that power which has changed the face of the civilized earth, and linked together in one bond the inhabitants of far separated climes?

Theoretically, our modern agricultural practice is as much a manufacture as the spinning and weaving of cotton, or the smelting and puddling of iron. The farmer, in his character of a food producer, has the same right to be termed a manufacturer of grain and beef, as the owner of the tall factory in his connection with the production of clothing from the raw textile materials which he works up. Late progress has indeed shown that we are advancing in our extension of the use of mechanical power in this direction; for, as our authority, previously quoted, observed on another occasion—

> "He had been very much delighted to see so good a show of valuable engines, some of them most ingenious, and very reasonable in price, for churning, hoeing, thrashing, and so forth. A friend of his, a practical agriculturist, informed him that a very important step had been taken for the purpose of saving labour, and thereby economising the expense of production—an object which, with care and judicious mechanical contrivances, was always in our power, even when we could not increase the fertility of the soil. The most valuable experiments had been made in the application of steam on a small scale. Thrashing machines, straw cutting machines, and various other engines, might be worked most advantageously by the application of steam; and he had the most confident, sanguine hope, that he should live to see this new and most valuable extension of the application of steam."

We have already whole armies of curiously-contrived cultivators: we must now introduce a cheap and easily available power to actuate them. This we have—at least for most ends—in the steam-engine; and our plates 38 and 39 may be taken as a fair example of the construction and arrangement best adapted, in the present state of our knowledge, for this purpose. The arrangement of this engine, to which we have given the name of the "Farmer's Engine," is by Mr. Robert Willis, of the establishment of Messrs. E. B. Wilson & Co. of the Railway Foundry, Leeds; and we are persuaded, that, as a farmer's prime mover, it will be found to possess qualifications of a good, if not a firstrate, order.

Referring at once to our plates—fig. 1, plate 38, is a complete longitudinal elevation of the engine as in working trim; fig. 2 is a transverse section, or rather a duplex transverse section—for it is taken through two points—corresponding; and fig. 3 is a plan of the whole, one-half being represented in horizontal section. It will at once be seen to be a modification of the ordinary locomotive engine of the inside-cylinder construction, with several ingeniously neat arrangements, fitting it for its intended purpose of locomotive and stationary power.

The cylinders, A A, are attached to the smoke-box end of the boiler; they are 6¼ inches in diameter, having a stroke of 10 inches. The crank connection is on the model of the well-known simple plan usually adopted in small direct-action engines, and in pumps, the piston-rod being prolonged to reach a guide, B, set forward, and attached to the boiler; whilst a short cross-head, keyed on the rod at C, furnishes joint-pins to carry the ends of the forked connecting-rod of the crank-axle, D. This axle, as in the arrangements of a similar kind formerly tried for locomotives, is detached from the driving-wheels, and runs in separate bearings of its own, carried in wrought-iron brackets, E E, bolted to the front end of the fire-box. It gives motion to the driving-axle, F, through the duplex spur-wheel arrangement, which admits of the obtainment of two velocities. On one side of the engine, the crank-axle, D, carries a spur-wheel, G, driving a pinion, H, on the main axle; whilst at the opposite side the movement is reversed, the pinion being on the crank-shaft. In this way, by sliding the crank-shaft wheel and pinion on their feathers, two motions of the crank-axle, in the relative ratio of 2¼ to 1, and 1 to 2¼, are obtained. The driving-axle, F, runs in bearings formed in curved wrought-iron brackets, I I, bolted to the sides of the fire-box; its pair of driving-wheels, J J, of 4 feet diameter, are entirely of wrought-iron, with round spokes riveted to a thin wrought-iron rim. Instead of being keyed on, as usual, the nave is bushed with brass, and accurately bored out to fit the plain-turned end of the axle, which is screwed up by a nut and friction-washer against a shoulder on the axle at K, the friction alone being found sufficient to give a secure hold.

The boiler is something extraordinary as an example of workmanship, presenting, in fact, a perfect novelty in its longitudinal joints of the barrel, as well as at the junction of the barrel ends with the smoke and fire-boxes. It is 5 feet 6 inches in length, and 2 in diameter, and has 28 wrought-iron flue tubes, 2½ inches diameter. It has two plates in its length, riveted transversely in the usual way,—whilst the longitudinal joint is a *weld* from end to end. This peculiarity has excited considerable attention, as well from its novelty as its excellency of execution. The smoke and fire-boxes are riveted to the barrel without the use of angle iron, the angle holding pieces being formed upon the barrel ends, to rivet to corresponding angles on the attached parts. The front carrying-wheels, L L, are 2 feet 8 inches diameter; they run loose on their axle, which swivels on a central pin carried by a wrought-iron plate at M, bolted to a flange on the lower sides of the cylinders. The central portion of the axle is flattened on its upper side, for bolting against the lower surface of a wrought-iron segmental toothed wheel, N, for steering. The steering handle is at O, close by the regulator handle; its stud-shaft carries a small pinion, gearing with a wheel on the rod, P, running along the top of the barrel of the boiler, and communicating motion by the pair of bevil pinions, Q, to a vertical shaft passing down the front of the smoke-box, and having a spur pinion, R, at its lower end, gearing with the wheel, N, on the axle. As the proper mode of steering common road locomotives has afforded much food for discussion, it may be remarked here, that this arrangement of Mr. Willis has been found to answer perfectly.

The regulator handle is in the usual place, S, at the front of the fire-box, from which a handle passes along the boiler to the regulator, T, in the smoke-box. The regulator is explained in detail by the detached views, figs. 4 and 5, on a scale one-fourth the real size. Fig. 4 is a longitudinal section of the regulator, and fig. 5, a plan, looking on the disc valve plate: U, is the brass valve disc, with two steam apertures, V V, corresponding to similar apertures in the cast-iron face, W, leading into the back of the valve-chest, whence pipes pass at X, to the cylinders. The face-piece, W, is kept up to its bearing in the valve case, by a set-screw passing through from the back; and when the steam pressure is low, the helix coiled on the regulator shaft, keeps up the valve to its face. In this engine, the regulator shaft passes into the supply steam-pipe, Y, at the bend, where it is made steam-tight by a conical collar on the rod, ground into a seat in the pipe, and kept in its place by the pressure of the packing against another collar at the fire-box end. In fitting this class of regulator into a locomotive engine, the pipe, Y, is made to extend along the whole length of the boiler, having a longitudinal slit $\frac{1}{16}$th inch wide along the top, to receive the steam, and to obviate the risk of priming, a strip of sheet-iron is laid over it as a loose cover. This arrangement does away with the necessity of a dome, or steam receiver.

In the present engine, a dome, Z, is used to receive the bent-up end of the steam-pipe, at the top of which a common throttle-valve, *a*, is placed, being set on a transverse spindle passing through the dome, and linked by a short lever connection, to the end of the lever, *b*, of the governor, carried on a stud on the side of the dome, to the curvature of which it is bent to pass round to the valve spindle. The governor is supported in an appropriate brass bracket, bolted on to the top of the boiler. It is driven from a small cord pulley, *c*, on the crank-shaft close to the driving pinion, and from this, a cord passes to a similar pulley, *d*, on the end of a short horizontal shaft driving the pair of bevil wheels of the governor. When travelling on the road, the governor is disengaged, and the throttle-valve is opened to its full extent, the ordinary regulator only being then used to control the movements of the engine. The force-pump for the boiler supply is bolted at *e*, to the side of the boiler; it takes its supply from a water cistern, *f*, placed beneath the ash-pan of the fire-box, from which a considerable amount of heat is derived, so that the water passes into the boiler in a warm state, by the entrance clack at *g*. An eccentric, *h*, on the crank axle works the pump-plunger by the connecting-rod, *k*, in the usual manner.

Such is the general detail of this "farmer's engine," which, we are sure, only requires to be known to be pretty universally introduced. Being locomotive, it is easily transferable from one part of a large farm to another, so that whilst to-day it is thrashing corn in one quarter, to-morrow it may be pumping water or grinding in another. It is now in the possession of Messrs. Ransome and May, the eminent engineers and agricultural implement makers of Ipswich, who are in this way paying a good deal of attention to the employment of mechanical power in connection with their other numerous improvements in agricultural matters. At the Leeds meeting of the Yorkshire Agricultural Society, it evidenced its standing by carrying off the first prize of its class, not solely, it may be added, on account of its appearance, but for what it has proved itself capable of doing. Some weeks' work in Ipswich, Norwich, and the neighbourhood, has tried its powers very fully. Here it was driven about the country by Mr. J. C. Wilson—from the builders' establishment —from farm to farm, and thus received both a locomotive and a stationary test. At Mr. Mumford's, of Bramford, it thrashed for two days, and another at Mr. Wood's farm, in the same district; as also at Mr. Frost's, near Freston; and, on the way to this place, it ascended Freston Hill, an inclination of 1 in 11. This it performed at a brisk walking pace, having, as is usual in travelling on the road, the slow motion in gear. On a level, it performed twelve miles within the hour easily.

When stationary, for driving any piece of machinery, the power may be taken from it three different ways. First, by a universal joint and coupling-rod screwed upon the end of the crank-axle, whilst the engine itself remains standing on its wheels, the spur-gearing being entirely disconnected; second, by the same, screwed on to the driving-axle; and, third, by a belt passed over one or both driving-wheels, which, in both the latter cases, are to be elevated from the ground by the axle-springs, with a prop beneath the fire-box.

With 41 lbs. of coal, steam is got up to a pressure of 45 lbs. in three quarters of an hour. In thrashing, its consumption of fuel is from 50 to 55 lbs. of coke per hour, evaporating in that time 41 gallons of water, driving two 4-horse thrashing machines, and, at a man's usual rate of feeding, of 13 coombs per hour, thrashing 260 coombs of grain per day of 10 hours. Its usual rate of working is 70 strokes per minute; but this, of course, depends upon the nature of its work. Its entire weight, with fuel and water supply, is 2 tons 10 cwt.

For large farms, we conceive that this engine will be a most effective assistant; and even on those of limited extent, if at all conveniently located, its powers of locomotion on a common road will render it quite available, as it can be quickly taken from one farm to another.

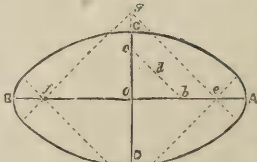
PRACTICAL GEOMETRY.

ON THE METHOD OF DESCRIBING AN ELLIPSE.

We have frequently had occasion to notice the difficulty experienced by many practical men in describing an ellipse, or a close approximation to that figure, through the four given points of the conjugate and transverse diameters. Very few of the more generally known methods will exactly fall in with these conditions; for, however accurately the directions may have been complied with, the figure will be found to be somewhere curtailed of its "fair proportions"—it will either cut a piece off each end of a diameter, or will encroach on the surrounding space, leaving the end of a line at a greater or less respectable distance from the periphery. We have seen a manager of a considerable foundry completely nonplussed, by the task of describing the elliptical shape of a boiler man-hole *exactly* to two given dimensions; and he actually completed the operation by the rule of trial and error—first taking a little bit too much, then the least bit too little, and so on until he at length hit upon the happy medium—greatly to the edification of a group of tyro mechanics, ourselves amongst the number, who had suggested to the great man the propriety of for once adhering strictly to the given dimensions. It is more than probable that such an exhibition as the foregoing will not often find its parallel; but we believe there are several mechanicians who would be glad of some information upon the subject, and to whom the following methods may prove useful. Those who are already well informed, will have their attention drawn to the problem; and if in possession of superior knowledge, we trust they will not leave their less fortunate companions in ignorance, but will avail themselves of our pages to diffuse their information.

The readiest method with which we are acquainted is to be found in "William Templeton's Millwright and Engineer's Pocket Companion," fourth edition, and is there described as Problem 17 of the Division of Practical Geometry. It is illustrated in fig. 1, but has the great drawback of producing a figure which differs very much from a true ellipse; but as it is eminently practical, as far as it goes, we give the method at length.

Fig. 1.



A B, C D, Being the transverse and conjugate diameters, set off A *b* equal to C *o*, and *c o* equal to *b o*. Join *b c*, and bisect it in *d*. Make *b e* equal to *b d* and *o f*, *o g* and *o h*, equal to *o e*, then are *e f g h* the centres of the circles required; and the points of junction can be ascertained by a line drawn through the centres to the circumference, as in the figure—our young friends bearing in mind that the fundamental principle of joining arcs of circles, without ugly jumps and shoulders, consists in preserving the point of junction in a right line with the centres of the describing circles. The eminent practicability of this method arises from the fact of all the angles being either half or whole right angles, so that by the assistance of a common right-angled isosceles triangle, or "set square" of 45 degrees, all the lines may be drawn and bisected with very little need of a pair of compasses. But most unfortunately the figure is so far out of the correct elliptical contour—especially as in the example, where the difference of the diameters is considerable—that its usefulness is very considerably proscribed, and it is always inadmissible in perspective. This leads us to look for a more correct, even if more tedious, method of solving the problem.

The method we employ—and which we believe has never before been published, and is certainly original so far as we are concerned, even if, from its self-evidency, it be not novel to some of our readers—is illustrated in fig. 2. A B, C D, Being the two given diameters, set off B *b*, equal to C *o*. Make *b e* equal to half *b o*, and C *c* equal to B *e*. Join *c e*, and bisect it in *d*, by the line *d h*, cutting the prolonged diameter at *h*. Make *o f* equal to *o e*, and *o g* equal to *o h*, then *e f g h* are the centres required, the points of junction being ascertained by lines drawn through the respective centres to the circumference. The peculiarity of this method consists in its suitability to all proportions of ellipses, and to all variations of the describing centres, whether attended by necessity or caprice, and its absolute correctness of principle may be proved as follows:—By the construction, the triangle, *c e h*, is an isosceles triangle, and therefore *c h* is equal to *e h*. And because C *c* is equal B *e* by the construction, and is also equal to *e i*, both being radii of the same circle, therefore C *h* is equal to *h i*—thus bringing the radii and centres of the circles to coincide exactly with the given points—this result being in no way dependent upon the peculiar position of the point, *e*, all the other members arranging themselves in accordancy with it wherever it may be placed. The method is thus confined to the ascertaining of the centres of the describing circles, and does not determine the *proportion* of the figure, which is dependent upon the position of the centres, *e* and *f*. Half the difference of the semi-diameter is the quantity taken in the figure, and will be found to be a convenient practical proportion, and to afford a close approximation to the true figure of an ellipse; but where more time can be devoted to the details, or greater accuracy is required, three-sevenths of the same space may be applied instead, although the increased trouble attendant upon the employment of such fractional parts is generally more than the improvement is worth.

Fig. 2.

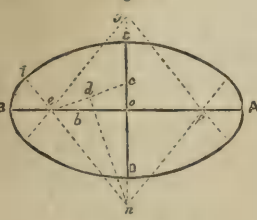
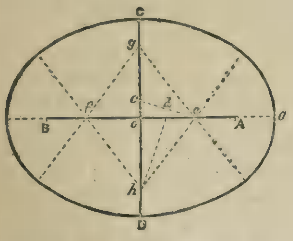


Fig. 3 is an instance of the principle modified to the condition of describing an ellipse from the two foci, A and B, and the conjugate diameter, C D. From the well-known fundamental property of the ellipse, that the sum of any two lines drawn from the foci to the same point in the circumference is equal to the transverse diameter, it follows, that the distances, A C and C B, are each equal to half the diameter, *a b*. Then from *o*, with the distance, A C or C B, cut the prolonged line which passes through the foci in *a* and *b*, which will be the extremities of the transverse diameter. The figure may then be constructed by the former method, or the points, *e* and *f*, may be at once determined by making (as in the example) A *e* and B *f* equal to *a* A or *b* B. This is merely an empirical rule; but the result is easily attained, and is generally satisfactory.

Fig. 3.



Figs. 4, 5, and 6, are three examples of the application of this principle to figures called "composite ellipses" by their inventor, Mr. D. R. Hay. They are the 40th, 46th, and 57th examples in his work, entitled "First Principles of Symmetrical Beauty." Their applicability to various ornamental purposes, as grease and oil cups, finial ornaments, &c., is sufficient to render them worth a little study. The original figure is formed by placing three pins at the angles of the triangle, A B D, and surrounding them with a cord of such a length, that, when strained outwards by a pencil, it will take the form of A C B D; the pencil is then carried round (still keeping the line stretched) and describes the figure required. The circumference is therefore made up of arcs of ellipses, of which A B, B D, and A D are the respective foci, the proportions of the figure being regulated by the angles of the primary and secondary triangles, A B D, and A B C. This furnishes the hint for our compass construction. Beginning with the upper portion, A C + C B is the transverse diameter, and C the extreme end of the conjugate of the first ellipse, whose centres can then be determined by the rules already given. The original construction also affords the means of finding the necessary points for the side ellipses, whose foci are at the angles A B D. For as the figure is described by a flexible line, equal to A C + C B + B D + D A, therefore the sum of any two lines from B and D, or from A and D, to the same point in their particular ellipses, must be equal to B D +, the difference between A B and A C + C B. In short, the transverse diameter of the two side ellipses exceeds the distance of the foci by the same quantity that the transverse diameter of the first ellipse exceeds the distance of *its* foci; the same addition must therefore be made to the side lines of the triangle as was made to its top line, and this will determine the side transverse diameters; the conjugates can then be found by the intersection of half the transverse as radii, from the foci as centres, and the remaining points ascertained as before. The centres for the necessary junction of the ellipses into one continuous line, will be found at the sides by the internal intersection of the radii describing the small end of the ellipses, and is indicated in the figures by small arcs; and at the bottom, by the intersection of the lines joining the centres of the great and little circles. These remarks, and the faint lines in the figures, will be found a sufficient guide to their formation. This class of ovals possesses great symmetrical beauty, and can be varied *ad libitum* by altering the size of the primary triangles, and the proportion of their angles; those figures most agreeable to the eye being formed on triangles, whose angles are in simple harmonic proportion.

Fig. 4.

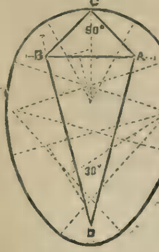


Fig. 5.

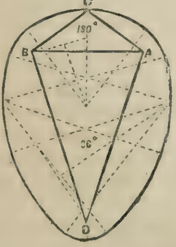
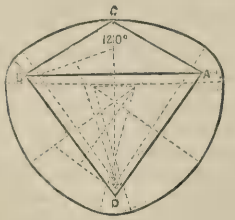


Fig. 6.



In conclusion, we have purposely abstained from noticing all ellipsographs, trammels, oval compasses, &c., leaving their consideration to a future opportunity, and confining ourselves to the use of an ordinary pair of compasses, as being more likely to be practical and generally useful in the workshop or factory.

D.

SECOND REPORT OF EXPERIMENTAL INVESTIGATIONS ON COALS FOR THE STEAM NAVY.

DETAILS OF EXPERIMENTAL TRIALS.

The results of these admirably conducted experiments have been fully explained in our previous pages; but as much is to be learned from an examination of the actual processes employed in the various tests, we have thought the matter sufficiently interesting and valuable to claim a place in this Journal under the title given above. In addition to the information given on this head, the present article furnishes useful notes on several points in connection with the production or manufacture of the fuels; the situations of the collieries and works; the system of working; market value and mode of transit; and, lastly, the behaviour of the various kinds under the boiler, and the peculiarities of composition and structure as affecting the treatment during combustion.

Lyon's Patent Fuel (No. 1).

This fuel, which is made of a mixture of pitch and coal dust, is manufactured into blocks having the following dimensions, 9″ × 9″ × 5″. Each of these masses weighs about 14 lbs., and has a mean specific gravity of 1·20. The bricks which were sent for the purposes of the investigation did not appear to be sufficiently pressed, many having become broken and almost reduced to powder during the transit from Swansea to London. Their shape is also less advantageous than that of some other varieties of patent fuel which have been experimented on. During the trials, it was found to produce the best results when thrown on the fire in large lumps, as it then evolves less smoke than when used in smaller fragments with more frequent stoking. This method of treating it is, however, attended with the inconvenience that the gradual meeting of the large blocks has a tendency to choke the draught, and thereby cut off from the burning mass the necessary supply of air. Whenever the fire was stoked, much smoke appeared at the chimney-top; but by careful management and constant attention, a good fire may be obtained from this fuel. During the trials but little soot was deposited in the flues, and little ash left on the bars; but a considerable quantity, both of cinder and clinker, was found at the termination of each experiment.

WELLEWOOD COAL.

The mine from which these coals were extracted is situated in the parish of Dunfermline, in the county of Fife, at a distance of 5½ miles from the town of Charleston, which is the shipping port. Its current price is 8s. 6d. per ton rendered on board ship. It is at present chiefly used by shipping, and is described by the proprietor as the "best in the district for steam purposes." The coals experimented on were the produce of two different veins. No. 1 was raised at a depth of 82 fathoms from the surface, whilst No. 2 was extracted from a part of the mine which does not exceed half that depth. Both veins have a dip towards the north-west, and are worked by the "long-wall system." The overlying strata are composed of shale; but the subjacent rock, not having been pierced, nothing is yet known of its composition. The proprietor gives no information relative to the regularity of the seams, but states No. 1, is 3½ feet, and No. 2, 4½ feet in thickness.

The specimens sent up for trial present the appearances of an extremely hard splint, with lines of fracture parallel to the planes of deposition. Little difference was observed between the samples 1 and 2, except that the former contained less iron pyrites and evolved less smoke during combustion than the latter. It was remarked during the experiments, that these coals lighted readily, and got up the steam rapidly, but emitted much smoke during the whole time of combustion. They do not, however, require much stoking, it being only necessary to push the heated coal from the dead plate on to the grate in order to insure a good fire. These coals, when burnt, leave a white ash and but little clinker, which is easily detached from the bars. They do not coke on the dead plate, but yield much soot of a light description.

EGLINTON COAL.

This colliery is situated in the parish of Kilwinning, to the north of Eglinton Castle, in the county of Ayr, and contains four seams. The main coal, which is 40 fathoms from the surface, and 4 feet in thickness, consists of two parts; the upper portion is 2 feet in thickness, and is composed of cubical coals, whilst the lower, which is a splint, is divided from the upper by a thin seam of fire-clay. Next to the main coal, at a depth of 34 fathoms from the surface, is found the "stone-coal" seam, which is 2 feet 6 inches in thickness, and, like the foregoing, divided into two parts by a band of clay. Two feet of the lower part of this seam are composed of splint, and 6 inches of the upper portion of cubical coals.

The Elle coal vein is found at a depth of 25 fathoms from the surface, and is also 2 feet 6 inches in thickness, 8 inches being splint, and the remainder cubical coals. The Ladyna, which is the last of these seams, and also the nearest the surface, has the same thickness as the two last mentioned, and produces both cubical and splint coals, although the former is found in the largest proportion. All these seams have an inclination of 1 in 12 towards the south-east, and are worked by the room and pillar method.

The distance of the mine from the shipping port, Ardrossan, is 6 miles, and the present market price 7s. 4d. per ton. It is chiefly sent to Ireland. The specimen of this coal, which was sent to Putney College for the purposes of the investigation, was beautifully bright, with indications of a cubical fracture; it, however, contained small quantities of iron pyrites and white shaly matter.

This coal was found, during the experiments, to light easily, burn rapidly, and evolve much smoke; it also requires to be stoked, like a splint coal, and leaves a white ash, with little clinker and cinder. The clinker does not attack the bars.

NEATH ABBEY COALS.

The Neath Abbey colliery is situate about 1½ mile from the port of Neath, and is worked on what is called the Brynddwey seam, which lies under the Drymma mountain. This vein has a regular thickness of 4 feet, with an inclination of 1½ inch in the yard towards the west, and is worked by level and inclined plane.

The coal, which is covered by hard rock, affording a good roof, lies on shale and fine clay, and is described by the proprietors as "non-bituminous and free-burning;" they also state that the same seam is explored at Graigola, Parson's Graigola, Ynisymmon, and Wernddu, where large quantities of coal are extracted.

The specimen sent for examination was very irregular in its structure, having no definite lines of stratification, but appeared an agglomeration of fragments rather than a series of regular deposits. When broken this coal yields fragments having the appearance of being rubbed on all their sides, and suggests the idea that at some period of its existence the vein must have been disturbed, and again cemented together by pressure.

Under the boiler it was found to light easily, and burn freely, with the evolution of much smoke. It was, however, found to swell on the bars, and thereby obstruct the draught, which requires the frequent use of the rake in order to keep up the fire.

At the close of the experiments rather large quantities of reddish ash remained, the amount of which was materially increased by the friable nature of the coals, which crumbled on the fire and fell through the bars. The amount of clinker was not very considerable, but that formed was found to adhere firmly to the bars, and not to be removed without difficulty.

BLACKBROOK RUSHY PARK COALS.

The mine from which this coal is extracted is situated at Rushy Park, Blackbrook, near the town of St. Helen's, Lancashire.

This coal is raised from distances varying from 150 to 280 yards from the surface, and is considered "hot and free burning." The vein varies from 4 feet 6 inches to 5 feet in thickness, and is free from accident.

The subjacent and overlying strata are shale and white stone, which, together with the vein itself, have an inclination of 1 yard in 7 towards the south-east. The extraction is at present carried on by means of open bays and levels. Its current price varies from 6s. to 7s. per ton at the pit. Liverpool is its principal market, and is situated at a distance of about 30 miles by water from the colliery.

Large quantities of these coals are used for steam purposes both by the government and other steamers belonging to the port of Liverpool.

The specimen of this coal sent for the purposes of the investigation was rather soft though brilliant, and evinced a tendency to divide itself into cubes, notwithstanding that the lines of cleavage were less distinctly marked than in many other varieties from the same district. There was also a nearly total absence of iron pyrites and shale, but a silky appearance often before referred to was very observable.

It was remarked during the progress of the experiments that these coals light easily, and get up the steam rapidly, but give off considerable quantities of smoke, both on lighting and stirring the fire, although, with careful stoking, little smoke will appear at the chimney-top. In order to avoid this, the coals should be partially coked on the dead plate, and from thence pushed on to the fire, by which means it will, in a great measure, be remedied.

The quantity of ash is small, and that portion which falls through the bars may be easily burnt by being again thrown on the fire. The clinker is small in quantity, and attaches itself firmly to the fire-bars.

BLACKBROOK LITTLE DELF COALS.

This colliery is situated at Little Delf Blackbrook, near St. Helen's, Lancashire; its present depth from the surface is 170 yards. The coals are extracted by means of levels and open bays from a regular vein of 3 feet 6 inches in thickness, which has a dip of 1 in 5 towards the south-east. The subjacent and overlying strata consist of stone and shale, and the coals are described as "clear and free burning." The price at the pit's mouth varies from 6s. to 7s. per ton, but by far the larger portion is sold at Liverpool, which, by water, is 32 miles distant from the mine. The proprietors state, that, when mixed with their Rushy Park coal, it forms good fuel for steam purposes. The sample very nearly resembles that last described, except that it contained large quantities of a white substance, which is found interposed between the lines of cleavage, and more particularly in those which are parallel to the lines of stratification.

This coal is also less firm than the last described, and has the lines of stratification more regularly and clearly marked.

During the practical experiments, no distinct difference between this and the Blackbrook Rushy Park coal was observed, except that of the two the Little Delf appeared the more smoky.

LYON'S PATENT FUEL.—*Specimens* 2 *and* 3.

These specimens were sent up for trial, as being supposed to be an improvement on that previously experimented on, inasmuch as No. 2 contained less pitch than the former sample, and in No. 3 had been incorporated one-seventh part of its weight of powdered anthracite.

In general appearance this fuel resembled in every respect that tested February 2, 3, and 4, 1848.

Its behaviour under the boiler was also precisely similar, except that No. 3 left a rather larger amount of ash, occasioned by the burning away of the other constituents of the fuel, whilst a certain portion of the anthracite remained unconsumed.

BLACKLEY HURST COALS.

Blackley Hurst is situated in the township of Billinge, in the parish and near the town of Wigan. Two seams are at present worked in this colliery—the one called the "four-foot vein," is mined at a distance of 60 yards from the surface, whilst the second, or "three-foot seam," has been followed to the depth of 140 yards. The average thickness of the former is 3 feet 10½ inches, whilst the three-foot vein is usually an inch less in thickness than its name implies. Both deposits are tolerably regular, and have each a dip of 20° to the south-east. The subjacent and overlying strata consist of "warren earth, black and blue shale, and bass." This coal is described by the proprietor as "clean and durable;" he also adds that it has been largely used by the Scotch and Irish steam-packets, and that the mixed produce of the two veins formed, during two years and a half, the supply of the Halifax and Boston mail steam-ships. It has also been employed for the manufacture of gas.

This coal in appearance resembles the Blackbrook Rushy Park; but contains in large quantities the white shaly substance before referred to.

It was observed, during the experiments, that this coal is slightly bituminous, and rather fragile, yielding much smoke, and depositing a considerable amount of soot. Little ash and clinker were, however, left, the latter being of reddish colour and very hard.

Johnson and Wirthington's Sir John Coals.

This coal, like the following, is raised in the township of Parr, near St. Helen's. The colliery is not, however, so deep as the Rushy Park, the coals being extracted from a depth of about 100 yards from the surface. The vein is 3 feet 3 inches in thickness, but is divided in the middle by a thin band of shale. The overlying and subjacent strata consist of sand, marl, flag, and stone coal of different kinds, though not of sufficient importance to pay for extraction. The vein has an inclination of one in six towards the north, and is worked by the long-wall system. This coal is described by the proprietors as "stubborn burning, and requiring a strong draught." Its shipping port is Liverpool, from whence the colliery is about 12 miles distant by land, and 30 by water.

The produce of this mine is chiefly used for furnace purposes, particularly by the glass-houses in the immediate neighbourhood, where it appears to have given satisfaction. The present current price is 6s. at the colliery, and 9s. at Liverpool.

It was observed during the experiments that these coals are lighted with difficulty, and require a very strong draught in order to keep up the combustion.

The fire-bars also became much choked towards the close of the day by the accumulated ash and clinker, of which considerable quantities remained at the end of each experiment.

Johnson and Wirthington's Rushy Park.

The Rushy Park colliery is situate in the township of Parr, near St. Helen's, Lancashire. The vein from which the coals are extracted is 4 feet 8 inches in thickness, and very regular, with a dip of one in seven from north to south. The overlying and subjacent strata consist of sand, marl, and black band, with various coal-seams of inferior quality. The coals are worked at a depth of 300 yards from the surface, by means of walls, and are described by the agent as "hot and swift." They are principally sent to Liverpool, where they are employed for steam purposes. The distance of the mine from the shipping port is by land 12 miles, and 30 by water. The specimen of this coal which was experimented on at Putney College, was extremely brilliant, and had well-defined and regular lines of deposition, between which occur large quantities of a white substance resembling sulphate barytes. As the composition of this matter might materially affect the quality of the coal, it was thought of interest to determine its constituents, which were found to be as follows:—

ANALYSIS.

Carbonate of iron,..	41·51
" lime,..	42·81
Sulphate of lime,..	1·79
Silica,..	·29
Magnesia,..	trace
Water,..	13·42
Total,..	99·82

It was ascertained during the trials made of this coal, that it lights easily, and burns clearly, blowing off much steam; but this, like all others from the same district, evolves much smoke, both on lighting and stirring the fire; it, however, produces but little clinker or ash, and appears to contain little or no iron pyrites.

Laffak Rushy Park Coals

The Laffak colliery is situated in the township of Parr, two miles north-east of the town of St. Helen's, in the county of Lancashire. The coals are raised at a distance from the surface varying from 150 to 400 yards, and are extracted from what is called the Rushy Park Vein, which is regular, and 4 feet 6 inches in thickness, with an inclination of one in six towards the S.S.E. The overlying and subjacent strata are strong blue flag, white rock, and blue bass. The coals are extracted by means of levels cut to the extent of the boundary, and then worked back by means of walls and bays.

The Sankey Canal, which is only 600 yards distant from the mine, affords an easy means of communicating with the Mersey at Runcorn, from which place it is conveyed by water to Liverpool, where it finds its market. The price at the pit's mouth is for screened coals 7s. 6d. per ton, to which must be added the expenses of shipping, which are light. Three pits or shafts have already been sunk on the "Rushy Park Vein, and by means of the powerful engines on the mine, 500 tons of coals may be daily extracted."

The specimen which was sent up for the purposes of the "Admiralty Coals Investigation," was hard and brilliant, occasionally presenting a conchoidal fracture, although it more generally manifested a tendency to divide itself into cubes. The lines of deposition were but indistinctly marked, and little iron pyrites was observed.

This coal also appears to be very free from the white shaly substance to which we have before referred, and which materially increases the quantity of clinker formed. Under the boiler it was found to light easily, burn clearly, and produce but little clinker; it has, however, the disadvantage of evolving much smoke, particularly after charging or stirring the fire.

Rushy Park Mine Coals.

The Rushy Park Mine is situated at Broad Oak, near St. Helen's, Lancashire, and is worked at a depth of 300 yards from the surface, where the seam is 4 feet 8 inches in thickness, with a regular dip of 1 in 5 towards the south-east.

The shipping ports are Runcorn and Liverpool, from the former of which places it is distant eight, and from the latter twelve miles. The present current price is 7s. per ton. They are described by the owners as "good bright coals, much liked for steam-packet purposes." They also further add, "We are now serving the Drogheda Steam-Packet Company, and the Liverpool Steam-Tug Company with the above coals, which give great satisfaction."

The sample which was sent for experiment differed little in appearance from other specimens from the same neighbourhood, except that it was perhaps rather brighter, and almost entirely free from iron pyrites, though it contained a considerable amount of the white shaly matter so frequently mentioned in former parts of this report. It was remarked during the progress of the experiments that this coal lights easily, and blows off a considerable amount of steam; it also makes a clear fire, which leaves but little ash and clinker, the former being of a reddish brown, and the latter of a very dark colour, approaching to black. Considerable quantities of a greyish smoke was evolved during the experiments.

Coal from the Llynvi Ironworks.

The five casks sent up for trial were the produce of five different seams occurring in the various mines belonging to the above Company.

As, however, the quantity of each coal sent to Putney for trial was not sufficient for a series of experiments, they were all mixed together, and afterwards tested in the usual way.

The coals contained in cask No. 1 were extracted from the Four-foot Vein Level, situated at Duffryn, and belonging to the Llynvi Iron Company.

This vein is four feet in thickness, is described as regular, and is worked at a depth of 80 yards from the surface. The coal is extracted by "pillar and stall," and is spoken of by the agent as "quick burning, and containing little ash." The specimens contained in Nos. 2 and 4 were the produce of the Nant y Crynwydd Mine, where the coal is extracted near the surface. No. 2 being wrought at a depth of 12 yards, and No. 4 of 14 yards. The specimen No. 2 is the produce of the "Furnace Vein," which is regular, and 12 feet in thickness. No. 4 was extracted from the "Seven-foot Seam," which is also regular, and 7 feet in thickness. The former seam is worked by "patch," and the latter by "pillar and stalls." The samples 3 and 5 were extracted from the Cocgnant Mines; the former at a depth of 40 yards, and the latter at a depth of 50 yards from the surface. No. 3 is the produce of the Yard Vein, which is 3 feet in thickness, and tolerably regular; whilst No. 5 was raised from the Caedafid Level, and is a slow-burning coal, leaving considerable quantities of ash. The thickness of this seam is 4 feet 6 inches, with an inclination towards the south-east. The specimens of these coals sent to Putney for the service of the "Admiralty Coals Investigation" were rather friable, but generally bright and clean in their appearance, with the exception of No. 2, which appeared from some cause to have been partially coked previous to its extraction from the mine.

It was observed during the progress of the experiments that these coals burn steadily, and give off but little smoke. The ash produced is of a whitish colour, and that portion which falls through the bars is generally so far consumed as to render its being again thrown on the fire unnecessary. The quantities of ash, clinker, and cinder, were also found to be rather considerable; but the clinker being of that porous kind which does not attach itself to the bars, its amount was not found to materially affect the combustion of the coals.

Rock Vawr Coal.

The Rock Vawr Colliery is situated in the Brombill Valley, parish of Margam, Glamorganshire, and is worked at a depth of 300 feet from the surface.

The vein is regular, and $3\frac{1}{2}$ feet in thickness, with a dip of $3\frac{1}{2}$ inches in the yard, 24° east of north. The subjacent strata are composed of rock, and the overlying of hard shale, having the same inclination as the vein itself. The mine is worked by cross-headings and stalls, and the coals are described as "free burning and slightly bituminous." The principal markets are Cornwall and Ireland; besides which large quantities are used for the smelting of copper ores, and for steam-vessels. This mine is two miles and a quarter from the shipping port, which is Swansea, where its current price is 8s. 6d. per ton. The specimen of this coal, sent to Putney for the purpose of examination, was rather soft, but bright in its fracture, and contained considerable traces of iron pyrites, but none of the shaly matter mentioned as occurring in the Lancashire coals. During the experiments this coal was found to light easily, and afford a good fire, without much smoke; but at the close of the operations, considerable portions of ash, cinder, and clinker remained, particularly of the latter, which had fused, and adhered rather firmly to the bars.

Newcastle Hartley Coals.

This coal is raised from the "Low Main Seam," and is extracted by the Spital Tongues Pit, within the borough of Newcastle-upon-Tyne.

The vein is worked to a depth of 48 fathoms, and varies from $4\frac{1}{2}$ to 5 feet in thickness. It is mined by board and pillar, the aid of gunpowder being constantly required. The vein dips $\frac{1}{2}$ an inch in the yard towards the south-east, and is, on the whole, tolerably regular. The overlying strata are composed of what is locally called "blue metal stone," and the subjacent of "grey metal stone," and impure coal. It is described as "bituminous, and free from sulphur, but throwing off considerable quantities of smoke during combustion." The current price is 7s. per ton at the colliery, which is two miles and a quarter from the shipping port. The proprietor, speaking of this colliery, says, it was established in 1835 by Messrs. Porter and Latimer, under a lease from the Corporation of Newcastle. The royalty extends under the town moor, which has a surface of 1,025 acres. The vend, during the year 1847, amounted to 87,113 tons, of which 59,055 were used within the port for steam and other manufacturing purposes; 11,083 were sent coastwise, principally to London and Scotland; and, finally, 17,005 tons were exported to the foreign markets, chiefly Spain and the Baltic.

It lights with difficulty, and requires a strong draught to carry on combustion economically; and that even then a large quantity of smoke is evolved. The ashes left are of a whitish colour, and in considerable quantity. The clinker is brittle, and does not adhere to the bars.

Balcarres Lindsay Coal.

This mine, which is the property of the Earl of Balcarres, is situated in the township of Upholland, in the parish of Wigan, Lancashire. Its present depth from the surface is only 40 yards, for the mine having been recently commenced, no extensive workings have, as yet, been effected. The vein is 6 feet in thickness, and is divided in the middle into two parts by 6 inches of clay. It has an inclination of one in five towards the north, and appears to be tolerably regular.

The subjacent and overlying strata consists of "argillaceous rock, blue metal, and black shale." Mr. Peace states, that this mine is worked by "narrow ends and walls, and in drifts about 5 yards wide."

The current price of the coal is 6s. 8d. per ton at the pit. The principal market is Liverpool, from which port the mine is distant about 12 miles by railway. The specimen of this coal was tolerably hard, with a cubical fracture and full black colour; but little iron pyrites was observed in it, although a considerable quantity of the white shaly matter mentioned in former parts of this report were perceived in the lines of stratification. During the experiments, it was observed to burn steadily and blow off the steam rapidly. After a certain time, however, the bars get partially choked by a brittle whitish clinker, which is found in rather large quantities at the close of the experiments. It has also, in common with other coals from the same neighbourhood, the disadvantage of giving off much smoke during its combustion.

Balcarres Five-feet Mine.

This mine is situated in the parish of Wigan, Lancashire, and is as yet only worked at a depth of about 40 yards from the surface. The vein is 5 feet 4 inches in thickness, and has been found to be regular so far as it has yet been proved. The subjacent and overlying strata are composed of "blue clay rock and black shale," which, together with the vein itself, have an inclination of 1 in 4 towards the north. This colliery is at present worked by walls, and is distant from Liverpool, which is the shipping port, about 13 miles. The coal is at present sold at 6s. 8d. per ton at the mine.

In appearance, it is similar to the last described, although the results of the experiments show its quality to be rather inferior to that from the Lindsay Mines.

It was found by experiment that this coal lights readily, and blows off the steam rapidly, but gives a hard clinker, which adheres so firmly to the bars as to interfere materially with the maintenance of a clear fire.

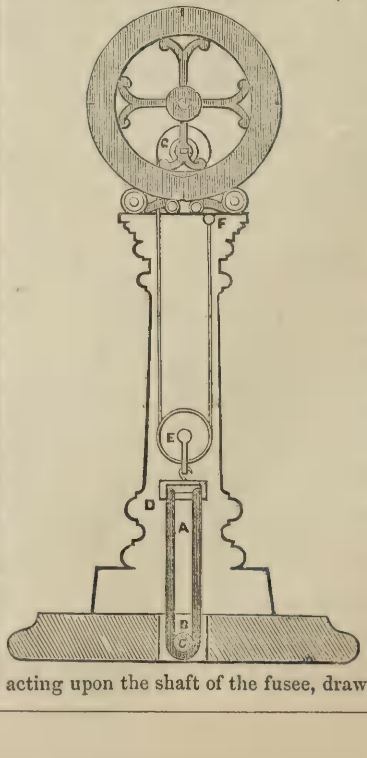
This coal gives off much smoke during combustion, and leaves a considerable amount of reddish ash.

Balcarres Haigh Yard Mine.

This colliery is situated in the township of Haigh, parish of Wigan, Lancashire, and is worked at a depth of 98 yards from the surface, where the vein is $34\frac{1}{2}$ inches in thickness, and very regular. The overlying and subjacent strata are composed of "argillaceous rock, indurated clay, and bass." The vein has an inclination of 1 in 20 towards the south-east, and yields a free burning coal. The present method of working is by narrow drifts about 12 yards apart, and bringing back the intervening space as breast work. The chief markets for the coal are Preston and Liverpool, from which latter place the mine is distant about 20 miles. The present current price is, at the mine, 6s. per ton; and if delivered at Liverpool, 9s. per ton is charged; but the cost of carriage will be considerably reduced on the opening of the Liverpool and Bury Canal. This coal resembles in appearance the two last specimens described, and was found during the experiments to burn in a nearly similar way, with the exception of its being consumed rather less rapidly and more steadily than the other specimens. The clinker was found to be small in quantity, but extremely fusible, and, by melting on the bars, obstructed the draught.

We shall follow up these details next month.

SMITH'S CAOUTCHOUC SPRING TIMEPIECE.



We are, this month, enabled to present a sketch of this timepiece, noticed in our last month's report of the proceedings of the Royal Scottish Society of Arts, page 190, *ante*. The engraving gives a full front view of the actuating spring movement, with the supporting column of the works, in outline. A B, Is the spring, in the form of a stout ring of vulcanized caoutchouc. It is doubled so as to bring the sides parallel, and the two ends are held by a pin at C, in the base of the stand. One end being put upon this pin, the doubled ring is passed through a slotted brass eyepiece, D, hooked to a moveable pulley, E, over which the fusee chain passes. One end of this chain is attached at F, to the top of the column, and after passing round the pulley, E, it proceeds directly to the fusee, G, the large wheel on which gives motion to the clock-train in the ordinary way.

As we have drawn the clock, the spring is supposed to be something more than half-run out. In winding up, the key, acting upon the shaft of the fusee, draws up the pulley, E, by the chain, until the spring is sufficiently distended, when the pulley is level with the top of the column, the elasticity of the spring then constantly tends to draw down the pulley, and thus acts with a continuous pressure to drive the works.

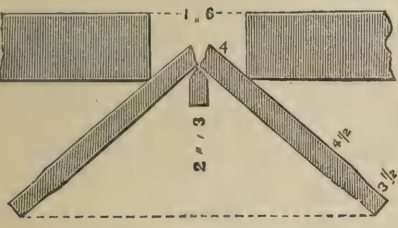
The inventor, Mr. W. Smith of Musselburgh, has had this ingenious arrangement at work in a clock for about 19 months, the same spring having been in active use during the whole of that time without exhibiting any alteration in its action; at any rate, the rate of the clock, as the surest test, remains the same. Of course, this species of spring is not applicable in all cases; but where the construction of the clock permits, it offers a simple, economical, and correct power for all horological purposes. In particular, and as distinguishing it from the coiled steel spring, there is an absence of all that friction which is so destructive of uniformity of power. The new material may be applied as a spring in various ways; but the one we have given is easily arranged, and appears to be effective, inasmuch as it gives the spring a perfectly direct action.

RAILWAY IMPROVEMENTS.

THORNEYCROFT'S AXLES, TYRES, AND RAILS.

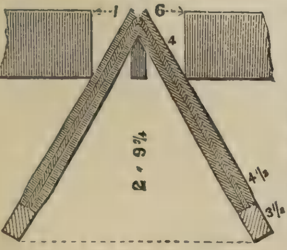
Most of our readers will remember the late disturbance in the direction of the Shrewsbury and Birmingham line, arising from certain remarks made by Mr. Chas. Geach, the maker of Hardy's patent axles, upon the conduct of Mr. G. B. Thorneycroft, the well-known iron-master and axle-maker of Wolverhampton. The remarks in question went to show that the latter gentleman, in his capacity of director, had, with others, been actuated by improper motives, in the selection of a certain make of axle for the use of the line. With business disputes of this nature neither we nor the public have anything to do; and we refer to the present case simply to introduce the subject-matter of the present article, which originated in a desire, on Mr. Thorneycroft's part, to explain the practical reasons which guided himself and brother directors in their choice. With regard to this, Mr. Thorneycroft states—" When the patentee set forth the superiority of the compound axle, I recommended the committee not to try one man's iron and make against another's, but to test the principle, by having one solid axle made, and one compound axle from the same quality of iron, by the same workmen, heated in the same furnace with the same quantity of coal, rolled in the same rolls to the same size, and at the same time. This was done, and they were sent to the Messrs. Lloyds to be tested, from whom a certificate was returned of the result, which was as follows:—The solid one broke in two with a pressure of $78\frac{1}{4}$ tons; the compound one fractured through only one-half of the hollow axle at $89\frac{1}{4}$ tons, leaving the inner axle perfectly sound, which was afterwards broken by tension. Upon this proof the selection was made, and orders given out; after which Mr. Geach made his charges to our chairman, and also through the public newspapers. To further satisfy myself and the committee, I had the axle, No. 2, taken from the bulk, and drawn down to the same shape and size as the patent shaft one, which so altered its due proportion as to much weaken it; and to prove this fact, I sent one out of the bulk without altering it from its due proportions; and the result fully shows the superiority of the compound principle. I am bound to say, the patent shaft axle was as good as any solid axle can be made. All these samples, with the certificate of the test, can now be seen by any one who will call at our works and look at them."

No 1.



1-27th.

No. 2.

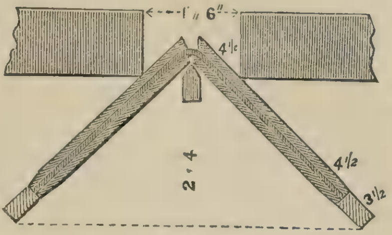


1-27th.

The axle, marked in our figures No. 1, as depicted under the breaking test, is one of Hardy's patent shaft axles; it has, along with the others, all the sizes marked upon it. Its breaking weight was 56 tons, when a clear fracture occurred in the centre. Weight of axle, 2 cwt. 2 qrs. 12 lbs.

The one marked No. 2 is termed the patent compound axle—Briggs' patent—as made by Mr. Thorneycroft. The principle of its construction is the introduction of a malleable iron bar into the centre. It is inserted during the operation of rolling, and its ends are subsequently welded into the centres of the journals, as indicated by the light-sectioned ends of our figures. The axle thus consists of a tube, with a separate tension bar passed down its centre. The tube is first welded, and partly rolled; and, at this stage, the central bar, $1\frac{1}{2}$ inches diameter, is introduced cold during the finishing part of the rolling. The breaking weight on the present occasion was 67 tons, the upper section of the tube only being fractured. Its weight was 2 cwt. 2 qrs. 6 lbs.

No. 3.

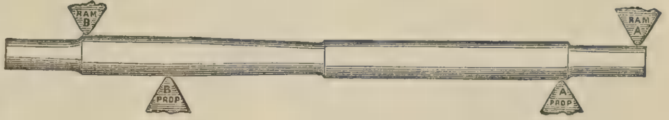


1-27th.

In No. 3, also a patent compound axle, the breaking weight was 110 tons, the outer portion only being quite broken. Its weight was 2 cwt. 3 qrs. 18 lbs.

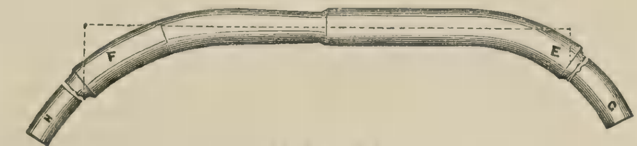
In some additional tests of this axle, as conducted by Mr. Robert Bowman, it was made of the peculiar form represented, in order to ascertain what effect the reduction of the axle in the centre would have on its strength, compared to an unreduced one, while under the different forces to which axles are subject when in use. Two courses of experiments were tried with this axle, the force applied being the impact of a large ram, 460 lbs., falling $11\frac{1}{2}$ feet, the momentum of each blow being upwards of $5\frac{1}{2}$ tons. A A, Shows the relative position of prop and ram in the first course of experiments—this position has relation to both ends (both ends were broken off, as shown in fig. 5); B B, shows the relative position of prop and ram in the second course of experiments—this position has relation to both ends (both ends were bent, as shown in diagram, No. 2). During both courses of experiments the axle was loaded in the centre, and on the extreme end.

Fig. 4.



$\frac{1}{2}$ inch = 1 foot.

Fig. 5.



$\frac{1}{2}$ inch = 1 foot.

First Course of Experiments on Ends G and H.

End G broke off at the fourteenth blow of the ram; the deflection previous to the last blow was 154°. This end was $\frac{1}{16}$ less in diameter than end H. End H broke off at the fifteenth blow of the ram; the deflection previous to the last blow was 148°. It appears, therefore, that in the strength of the two ends to resist impact, there is little or no difference—end H being $\frac{1}{16}$ larger than end G.

Second Course of Experiments on Ends E and F.

End E received 46 blows of the ram, and bent to an angle of 162°. End F received 16 blows of the ram, and was bent to an angle of 157°. From the last experiments, it is very evident that, by reducing the axle in the centre, the strength to resist impact on that part where the wheels are fixed is reduced from 46 to 16—thus showing $187\frac{1}{2}$ per cent. in favour of the unreduced axle.

Again, an axle of the same make was reduced to 4 inches diameter in the centre, and was subjected to transverse strain, when it fractured to the inner bar with 68 tons; while an unreduced axle, of $4\frac{1}{2}$ inches diameter, bore 116 tons, without the least appearance of fracture—thus showing a per centage of $70\frac{1}{2}$ in favour of the unreduced axle.

Again, as the strength of axles to resist torsion is as the cubes of their diameters and velocities, then the unreduced axle is 42 per cent. stronger than the one reduced in the centre.

The weight of an axle unreduced is	*cwts.*	2	3	18
The weight of an axle reduced is		2	2	6
			1	12 saving of

weight; but the reduced axle being 1s. per cwt. dearer than the unreduced one, the saving in cost by using the reduced axle is but trifling.

Loss of strength to resist impact	187½ per cent.
Loss of strength to resist transverse strain	70½ ,,
Loss of strength to resist torsion	42 ,,

The excessive laminating action constantly going on in rails of the usual piled or fagotted iron, under the severe weight of the modern locomotive, is too serious a matter not to have received a great share of attention from practical rail-makers. Amongst these, Mr. Thorneycroft has distinguished himself by the production of a rail with a homogeneous top, or bearing surface, which most effectually prevents the destructive wear referred to.

Figs. 7 and 8 represent sections of his improved charcoal iron rails, one-fourth the real size. The whole of the upper dark surface, in both these examples, is made of hard charcoal-iron, whilst the under, or fibrous portion, is of No. 3 puddled iron. The same principle is also applicable where puddled iron is used for the bearing surface, the wearing portion being still free from lamina, but not so hard as the former.

Fig. 6.

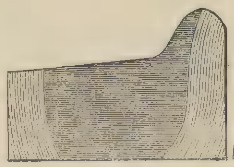


Fig. 7.

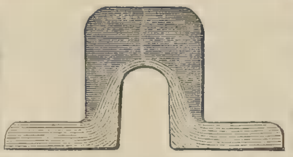
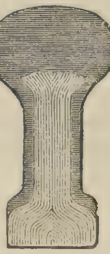


Fig. 8.



In the manufacture of these rails, the best pig or refined iron is puddled, and formed into a single ball sufficient to form the bloom required for the wearing portion of the rail. The required weight being thus obtained in one mass, it is not worked down or piled, but the requisite ductility is obtained by compression, so as to bring its specific gravity to about the same point as when piled and rerolled into No. 2 or No. 3 bar-iron, as generally used for the surface of fagotted rails. In using charcoal-iron, the pig or refined metal is made malleable in the charcoal refinery, bringing it out in one lump sufficient for the required bloom.

The same principle is applied in the manufacture of tyres. Fig. 6 is a section of a tyre, drawn to the same scale as the rails, where the dark wearing portion is composed of crystalline charcoal-iron, and the outward portion of a mixture of India charcoal pig, with the toughest fibrous iron.

A machine has been made at Mr. Thorneycroft's suggestion, and, we believe, at his expense, by Messrs. Fox, Henderson, and Co., for testing all railway axles and tyres free. If his offer is properly carried out and attended to, we shall probably hear less in future of the serious defects in this class of railway mechanism, at present of too frequent occurrence.

PHYSICAL GEOGRAPHY.

No. II.

Although we speak of oceans, there is in fact but one ocean, stretching from one pole to the other, from the bottom of which rises the land in the form of continents and islands; however, we divide this vast body of water into portions, to which we give different names. Internal or mediterranean seas are those which are nearly surrounded by land, and which are connected with the main ocean by means of narrow channels, on which the names of strait and channel have been bestowed. Gulfs, bays, and bights are those places on the coast where the land yields to the sea, which thus penetrates towards the interior; and when they are on a small scale, and are favourable to the anchorage of ships, they are termed harbours, roads, or ports. Long narrow indentations in the land, filled by sea water, are denominated lochs or fiords. On the coast of Norway, these fiords occur in such numbers as to give a peculiar character to the scenery.

The bottom of the ocean presents irregularities as great as those found on the surface of the land, but no attempt has yet been made to construct a map of them. Indeed, we know too little of these irregularities, except in the neighbourhood of submarine land, to enable anything of the kind to be done. Perhaps about five miles may be assigned as the mean depth of the ocean. The greatest depth hitherto attained is 27,600 feet; Ross sounded in S. lat. 15° 3′, and W. long. 23° 14′, to this depth, without reaching the bottom.

Sea water is loaded with a large quantity of chloride of sodium (common salt), but where it obtained this matter is a difficult question to determine. It also holds in solution sulphate of soda, chloride of calcium, and chloride of magnesium, and these salts communicate to it a nauseous bitter taste. Dr. Marcet's analysis of water, from the Atlantic Ocean, gave the following proportions:—

Water	478.420
Chloride of sodium	13.3
Sulphate of soda	2.33
Chloride of lime	0.995
Chloride of magnesia	4.955
	500 grains.

The quantities of these salts differ with different localities. The southern ocean has a little more salt than the northern; and the inland seas have less than the main ocean, in consequence of the large quantities of fresh water they receive. The Caspian, for instance, has only one-sixth part of the saltness of the ocean. The Mediterranean is an exception to this rule. No process has yet been discovered by which sea water can be readily freed from extraneous matter, and rendered fit to drink.

The specific gravity of sea water varies from 1.0269 to 1.0285. It freezes at 28° Fahr.

The variety of colour in the sea has never been fully accounted for. In the open ocean it is deep blue; near the shores of England, France, and Holland, green; in the Gulf of Guinea, whitish; in the Gulf of California, reddish; at the opening through the coral reefs round the Maldives, black; and the Black Sea, on the shore of Western Russia, merits its name. In the centre of the Red Sea, the water is blue; but, as the shore is approached, that colour gradually changes to light green. Near the rock of Gibraltar, the sea suddenly alters from deep blue to green, where the soundings indicate a change from 24 to 16 fathoms. It is usual to represent the blue tint to be owing to the same cause as the colour of the sky: the blue rays of the spectrum having a greater refrangibility than the rest, and being therefore reflected in the greatest quantity.

The luminous appearance which the sea, especially in warm latitudes, exhibits, is another phenomenon, the cause of which is not clearly known. It is sometimes seen, to a small degree, on a summer's evening, on our own shores; but near the equator, the whole surface of the ocean frequently seems a flood of brilliant light. The most agitated parts, such as the crest of a wave, the wake of a ship, the places struck by the oars, appear like a liquid on fire; and even fishes, when of a large size, such as porpoises, leave a fiery train behind them. The phenomenon is ascribed by some to animalcules possessing phosphorescent qualities, chiefly of the medusa species; by others, to the phosphorescence of animal and vegetable matter in a state of decomposition; by others, to electrical action. Humboldt believes it to be produced by animalcules: "The magic brightness belongs to organic nature; each breaking wave curls in luminous foam; the whole wide expanse sparkles, and every spark is the vital movement of a minute and otherwise invisible world of animal existence."

Although the surface of the ocean is less rich in animal life and vegetable forms than that of continents, yet, when its depths are searched, perhaps no other portion of our planet presents such fulness of organic life. Our land forests do not harbour so many animals as the low wooded regions of the ocean, where the sea-weed, rooted to the shoals or long branches of fuci, detached by the force of waves or currents, and swimming free, upborne by air-cells, unfold their delicate foliage. Throughout its mass, we find animal existence; and at depths exceeding the height of the loftiest mountain chains, the strata of water are alive with polygastric worms, cyclidiæ, and ophrydinæ,—and here swarm countless hosts of minute luminiferous animals. The abundance of these minute creatures, and of the animal matter supplied by their rapid decomposition, is such, that the sea water becomes a nutritious fluid to many of the larger inhabitants of the ocean. And not only is there no interruption of minute microscopic forms of animal life in the vicinity of the poles, where larger animals cannot maintain themselves, but there is a remarkable abundance of new forms, often of great elegance. The ocean water, in its ordinary condition, contains innumerable microscopic organisms floating in a fragmentary shape, like the oscillatoria of our fresh waters.

The surfaces of the great oceans, and the seas connected with them, may be regarded as having the same level; though it is said, that at the Isthmus of Panama, there is a mean difference of level between the

Pacific and the Atlantic of ten feet; but it is not at all improbable that there is some error in the admeasurement. It is also said, that the northern extremity of the Red Sea is from 24 to 36 feet higher than the Mediterranean. Local causes, such as winds and currents, may easily produce permanent differences of this kind in seas forming deep gulfs, particularly if the outlet of such seas be narrow.

The level of the ocean is subject to periodical oscillations, denominated tides, due to the attraction of the sun and moon,—the latter body having three times the influence of the former. The central area of the ocean is first affected, and then, from this oscillating centre, "partial tides diverge in all directions, whose velocity depends upon the depth and local circumstances of the sea. At the equator, the tide follows the moon at the rate of 1,000 miles an hour; but the derivative tides are so retarded by the form of coasts and irregularities at the bottom of the sea, that a tide is sometimes impeded by an obstacle until a second tide reaches the same spot by a different course, and the water rises to double the height it would otherwise have attained: a complete extinction of the tide takes place when a high water interferes, in the same manner with a low water, as in the centre of the German Ocean; and when two unequal tides, of contrary phases of rise and fall, meet, the greater overpowers the less, and the resulting height is equal to their difference."

The duration of the oscillations is a little more than half a day. For six hours the sea, at every point along the equator, in succession, rises or flows, until it has attained its maximum height, called high tide; for the next six hours it falls or ebbs, until low tide is produced, and then the process is repeated.

The tides correspond with the passage of the moon across the superior and inferior meridians, and thus, in the course of a lunar day (24h. 50m.), there are two, and each tide is lower by 25m. than the preceding one. The highest tides take place at the epoch of the full and new moon; the lowest at the quadratures. Their height is proportional to the distance of the sun and the moon from the earth, and to the relative position and declination of these two bodies. It is just before the spring, and after the autumn equinox, that the highest tides of all are observed. Their ordinary height, in the open ocean, is not more than a few feet, but the configuration of particular coasts, opposing the progress of the tidal wave, causes it to rise considerably higher. Whilst at St. Helena it never rises more than three feet; at St. Malo, on the French coast, and on some parts of the British coast, it rises fifty feet; and in the Bay of Fundy, in Nova Scotia, it rises sixty feet. Owing to the land-locked character of the Mediterranean, the Caspian, and some of the deeper gulfs, tides are scarcely perceptible. Local circumstances sometimes make a great difference, in the time of high tide, at two places not far distant from each other. For instance, there is a difference, in this respect, of six hours between Dunkirk and St. Malo. Mathematicians have enabled us, by their calculations, to predict the height of spring tides at the periods of new and full moon.

Many parts of the ocean are traversed by currents which originate in a variety of causes, amongst which may be reckoned the propagation of the tide wave in its progress round the globe, prevailing winds, variations of density in the water in different latitudes and depths, by changes in the temperature and the quantity of saline matter, the horary variations of atmospheric pressure, and the accession of large bodies of fresh water from great rivers. These currents carry warm water into higher, and others cold water into lower latitudes; they are well defined, and move like rivers between water in a state of repose. The equatorial or equinoctial current may be regarded as caused by the trade winds, and the progressive propagation of the tide wave. It flows from east to west with a velocity of nine or ten miles in twenty-four hours, and being met by the drift current impelled by the south-east trade wind, by which it is banked up on the south and gradually augmented, it strikes upon the easternmost angle of South America, and divides into two branches, one of which travels southward to Cape Horn, and the other is impelled to the Caribbean Sea and the coast of Honduras, where, meeting with opposition, it passes into the Gulf of Mexico, between the promontory of Yucatan and Cuba. This is the celebrated gulf stream. It winds out of the Gulf of Mexico and strikes northward, widening as it advances, so that, though it is only fifteen leagues broad near the Bahama bank, it is eighty leagues broad in the latitude of Boston. It then turns to the east, and touches the southern extremity of the bank of Newfoundland, where its waters are nearly 23° warmer than those of the bank. It then flows eastward to the Azores, thence towards Gibraltar and Madeira, and, bending to the south-east, pushes towards the African coast. It is thus blended with its original source within the tropics, making its circuit of 15,000 miles in about two years and ten months. Its maximum of motion is in the Bahama channel, where it has been observed to move, in spite of the opposition of a violent north wind, at the rate of five feet in a second of time. For a considerable portion of its course, the waters of this current are distinguishable by their elevated temperature, which is sufficiently great to warm the adjacent temperature, by their saltness, their indigo-blue colour, and the quantity of sea-weed which they bear along with them.

In the Southern Pacific Ocean, there is a current which brings the cold water of the high south latitudes to the coast of Chili, and follows its shores and those of Peru northward to the bay of Arica, and thence north-westerly to the neighbourhood of Sayta, where the most westerly projection of America causes the stream to leave the shore and take a due west direction. At some seasons the temperature of this current is 60° Fahr., whilst the surrounding ocean is from 81° to 83° Fahr. As to the depth of these currents, we have no certain knowledge; but there seems reason to abandon the notion, at one time entertained, of there being submarine currents setting from the pole to the equator.

Whirlpools and eddies are formed by the meeting, in a narrow channel, of currents running in opposite directions. Charybdis, in the Straits of Sicily, and the Maelstroem, on the Norwegian coast, are the most dangerous of these phenomena.

"The common cause of waves," says Dr. Arnott, "is the friction of the wind upon the surface of the water. Little ridges or elevations first appear, which, by continuance of the force, gradually increase until they become the rolling mountains, seen where the winds sweep over a great extent of water. The velocity of waves has relation to their magnitude. Large waves proceed at the rate of from thirty to forty miles an hour. It is a vulgar belief that the water itself advances with the speed of the wave; but, in fact, the *form* only advances, while the substance, except a little spray above, remains rising and falling in the same place, with the regularity of a pendulum. A wave of water, in this respect, is exactly imitated by the wave running along a stretched rope when one end is shaken. But when a wave reaches a shallow bank or beach, the water becomes then really progressive; for then, as it cannot sink directly downwards, it falls over, and forwards, seeking the level." It is afterwards asserted by the doctor, that no wave rises more than ten feet above the mean level of the sea, but the recent observations of Captain Stanley show that this height is often exceeded.

The Pacific Ocean has an extreme breadth of 4,550 leagues, and its length may be computed at 3,200 leagues. A great number of small islands are scattered over its surface, especially between 30° N. latitude and 50° S. latitude. European sailors entering it from the north, gave it the name of the South Sea. Magellan afterwards named it the Pacific, from the calm weather which he experienced upon its bosom; but it little merits the title, as it is generally a stormy agitated sea. It was discovered by Balboa in 1513, when he looked down upon it from mountains in the Isthmus of Darien.

The narrowest part of the Atlantic, namely, between Europe and Greenland, is more than 1,000 miles wide, and its greatest breadth is 4,200 miles across. One-seventh of the whole superficies of the globe may be assigned to this ocean with its gulfs. Not far from the Azores there is an immense bed of sea-weed, called the Sargasso Sea, through which Columbus sailed on his first voyage to the west. It remains nearly stationary, and forms a habitation for a countless number of marine animals.

The enormous loss to which the ocean is subject at its surface by evaporation, would very rapidly diminish its bulk were it not fed by fresh supplies. These supplies it obtains by means of that very evaporation. The vapour which ascends into the atmosphere, descends to the ground in drops of rain, and, sinking into it, issues again at some lower point in the shape of springs—the feeders of rivers, which pour their accumulated contributions into the ocean. The largest rivers in the world are to be found in the American continent. The Amazon, or Maranon, has a length of more than 4,000 miles, 2,500 of which are navigable by vessels of 500 tons burden, and it drains a tract of 2,275,000 square miles. The Amazon forms a current with a velocity of three miles an hour in the ocean, at a distance of 300 miles from the point where it quits the land. It crosses nearly at right angles a current of the ocean; and from the less specific gravity of the river water, it flows over as well as across the ocean current. The Plate River has a course of 2,400 miles, and the area of its basin is computed at 1,240,000 square miles. Rennell states that the current occasioned by the discharge of this river preserves an easterly direction, and is found to have a velocity of a mile an hour, and a breadth of 800 miles, at a distance of 600 miles from the mouth of the river. The Orinoco has a direct course of 1,200 miles. It is curiously connected by the river Negro with the Amazon. In North America, the Mississippi has a length of 3,000 miles, receiving in its course the Missouri, which, at the point of junction, is both longer and broader than the stream it joins.

In Asia, the principal streams are the Ganges, the Indus, and the Irtisch. In Africa, the Nile and the Niger. In Europe, the Danube the Rhine, the Rhone, the Vistula, the Volga, and the Dnieper. In the British Islands there are eight rivers, each of which drains an area of between 2,000 and 10,000 miles; the tract drained by the Humber, the most extensive, being estimated at 9,550 square miles.

All rivers carry down their channels a quantity of solid matter and debritus, the amount of which depends upon the volume of water and the strength of the current. This is deposited near the mouth, and forms large tracts of level alluvion, termed deltas. The city of Astrakhan is built on the mud of the Volga. One of the mouths of the Dnieper has been blocked up by the deposit of earth brought down into the Black Sea. Some rivers raise their beds; for example, the Po, the level of which is higher than the houses of Ferrara. Most streams, however, deepen their beds by friction.

Lakes are formed by hollows on the earth's surface, into which streams penetrate, and fill with water, which rises until it can find an escape. The largest lakes in the world are found in North America, where a chain of them extends over nearly 8½ degrees of longitude, and the extent of their surface is computed at 93,000 square miles.

	Length in miles.	Width in miles.	Area in square miles.	Average depth in feet.	Height above sea in feet.
Ontario,	180	40	5,300	500	232
Erie,	270	80	9,600	84	565
St. Clair,	—	—	360	20	571
Huron,	250	100	30,400	1,000	584
Superior,	480	109	22,000	900	628
Michigan,	400	50	——	1,000	584

The deepest soundings have been made in Lake Huron, 1,800 feet of line having been let down in one part of it without reaching the bottom. That part of it, therefore, is more than a thousand feet below the level of the sea. The lakes of Europe may be considered as rivers or streams widened and deepened in a part of their course, such as the lakes of Geneva, Constance, Maggioro, &c. The Dead Sea, and the Lake of Titicaca in America, receive considerable affluents, without having a channel for carrying off water.

The speed with which rivers flow to the common receptacle of them all, depends, of course, on a variety of circumstances, the principal of which are the height of the source, and the length of the course. It varies frequently in the same river. Although the fall partly influences the velocity, it does not do so to such an extent that the rate of fall can be taken as a scale for the rate of velocity. The Rhine, the Danube, and the Elbe are rapid rivers, yet they have only a fall of one or two, seldom three, feet per mile. The Tweed runs at the rate of 8 feet per mile; the Severn has an average descent of 26½ inches per mile; the Shannon of only 9 inches. The Jordan has the extraordinary fall of nearly 16½ feet per mile. When a river has to descend over a steep slope, or has to work its way amongst rocks, the place is called a rapid; and where it has to make a descent in its course by a leap, or a series of leaps, we have a waterfall or cascade. Such places, when on a large scale, attract many visitors, and are well known, at least by name. The Falls of Niagara, of the Rhine at Schaffhausen, and of the Trolhatten in Norway, have been described a thousand times. One of the highest falls in the world is that of Tequendama in New Grenada, South America. The river suddenly contracts itself from 144 to 12 feet, and then throws itself over a precipice of 574 feet. A still greater fall occurs in the Himalayas, that of Pabur, to which a descent of 1,500 feet is attributed.

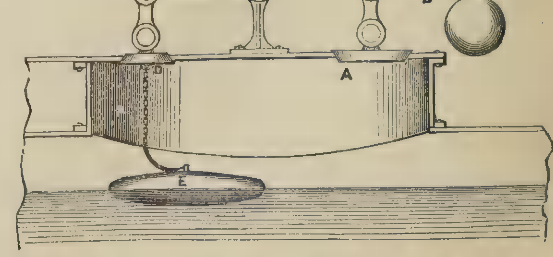
Springs of water are frequently impregnated with foreign matters to such an extent, as to give them a specific action on the animal economy, and many of them have been found extremely useful in the treatment of diseases. They may be divided into four classes—acidulous or carbonated, saline, chalybeate or ferruginous, and sulphureous. Those of the first class contain a large quantity of carbonic acid, free, or in combination with various minerals, and have a sensible acidulous taste. The waters of Bath, Buxton, and Bristol, of Vichy and Mont d'Or in France, of Seltz in Germany, belong to this class. The principal ingredients in saline springs are sulphates of magnesia and soda, carbonates of soda and lime, and chlorides of sodium and calcium. The springs at Epsom and Cheltenham, Carlsbad, Toeplitz, and Seidlitz, Bohemia, and Saratoga, United States, are examples of this class. The chalybeate kind owe their properties chiefly to the presence of iron, which gives them a styptic taste, and is held in solution by carbonic or sulphuric acid. Tunbridge Wells, Spa in Belgium, Pyrmont in Westphalia, are examples of ferruginous waters. Sulphureous springs have a very disagreeable taste and smell, which are owing to sulphuretted hydrogen. They contain various salts in addition. The waters of Harrowgate and Aix la Chapelle are sulphureous.

Many of these springs are thermal—that is, they issue into the air of a temperature higher than that of the atmosphere. The heat varies from tepid up to being nearly that of boiling water. One of the hottest is the Aquas de Comangillas, near Guanaxuato, in the Mexican territory, which has a temperature of 205½° Fahr.

When mountains pass the line of perpetual snow, their hollows frequently contain glaciers. These bodies are formed of snow, half melted by the heat of the sun during summer, and which, by the cold of night and of winter, becomes frozen into ice, having a considerable degree of porosity and plasticity. From the main trunk or basin of the frozen lake, there descend, through ravines into the neighbouring valleys, arms or branches, from the extremity of which issue streams formed by the melting of the icy matter brought into contact with ground warmer than itself, and by the filtrating of water, which the sun's rays melt on its surface. Glaciers have a progressive movement along their troughs (from twelve to twenty-five feet annually in Europe), which movement, though slower in winter, does not stop even at that season. When the superficial drainage collects and flows through deep holes into the centre of the glacier, there are *moulins*, or cascades, which, notwithstanding the motion of the icy body around them, are always found at the same spot. The rocks and stones which the destructive powers of the elements cast upon the surface of the glacier, and which afterwards sink into the body, are carried along some distance, and are thrown off at some lower point. A wall of loose matter is thus accumulated at the sides and termination of a glacier, which is termed a *moraine*. From observations conducted amongst the Alps, with great patience and sagacity, by Professor Forbes of Edinburgh, it appears that a glacier may be considered as an imperfect fluid, or a viscous body, which is urged down slopes, of a certain inclination, by the mutual pressure of the parts, and that the glacier stream, like a river, moves fastest in the centre. The surface is excessively rugged, and its mass is traversed by rents and fissures *(crevasses)*, at right angles to the direction of its motion. Upon close examination, it is found that a glacier is pervaded by a veined or ribboned structure, occasioned by bands of granular, whitish, opaque ice, and of pure transparent ice being alternated. On account of the greater porosity of the former kind of ice, it retains the sand and minute disintegrations of rock more than the other, and hence the surface of a glacier is perceived, in certain lights, to be marked with lines termed *dirt bands*, which, though parallel with each other, form a series of curves, with their convexities downwards, so that their apexes are in the centre, in conformity with the law of motion in confined fluid masses. Glaciers are exhaustless feeders of rivers wherever they exist. In those of central Europe, the Rhine, the Rhone, and the Po take their rise, and the Danube receives some grand supplies. It is computed that, in the Alpine range, there are between 1,600 and 1,700 square miles of glacier, with a thickness of from 80 to 600 feet. From the number of moraines in many of the Alpine valleys, and the striated marks on the rocks, apparently scratched by a moving body, some geologists entertain the opinion that glaciers were formerly much more numerous than at present; and they conceive that these bodies of ice were the agents by which those large masses of rock, called *erratic blocks*, were transported from their original sites to those they now occupy, hundreds of miles distant.

WILLIAMS' DUPLEX SAFETY-VALVE.

This valve, which was brought forward at the late meeting of the Royal Cornwall Polytechnic Society, has been contrived for a twofold object. In the first place, to prevent the inconvenience arising from the sticking of the ordinary valve to its seating, when from any cause the internal steam pressure falls below the atmospheric pressure; and secondly, to insure a greater regularity in the level of the water, or rather to prevent the dangerous consequences of its falling inordinately low. Our engraving exhibits a section of the man-hole of a boiler, with this valve fitted to it, complete. A, Is the safety-valve proper; it opens upwards in the usual way, and is linked by a short strap to the weight-lever, B, the fulcrum of which is at C, on the top of a fixed pedestal. The



weight-lever is formed in the ordinary way, with the exception that it is prolonged on the opposite side of its fulcrum for a distance equal to its length from this point to the link of the valve, A. To the end of this prolongation is linked a second, but smaller, valve, D, placed inside the man-hole lid, and opening downwards. In this way, any upward movement of the valve, A, produces a corresponding downward one to the same extent in the valve, D. The internal steam pressure tending to open the valves, will in effect be exerted only on the excess of the area of the larger valve over that of its neighbour; and this excess ought to be some whole number of inches, in order that, on an inspection of the loading of the lever, the actual pressure may be easily estimated.

If the steam pressure gets below the atmospheric pressure, the converse action takes place, the atmosphere then becoming the actuating medium. The contrivance is, in fact, as regards its primary office, a modification of the common equilibrium valve.

To the lower side of the valve, D, a float, E, is linked by a chain, the length of which is proportioned to the proper height of water-level. So long as the float is sustained by the water, the chain bangs loose; but when the level falls below its limit, the combined weight of the chain and float opens the valve, and blows off the steam.

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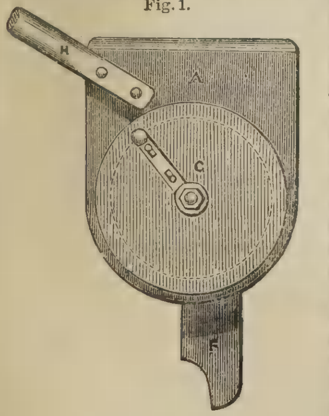
REGISTERED DESIGNS.

GARDEN DRILL.

Registered for W. F. Padwick, *Esq., Manor House, Hayling Island, Hants.*

This little implement presents some ingenious features, which render it of some importance as a drill for various purposes. Our engravings exhibit it under three views. Fig. 1 is a side elevation, on a small scale, as complete for work; fig. 2 is a transverse vertical section, through the centre of the drum, on a scale three times larger than fig. 1; and fig. 3 is a corresponding plan, the seed-box lid here being removed. The case, A, is rectangular, with a semicircular bottom, containing a disc, B, carrying a set of transverse arms, C C, each of which is furnished at its outer extremity with a cup, or small measure. The seed to be deposited is introduced to the case of the instrument by the aperture, D, and the depositing action is effected in a clever manner by the revolution of the cupped arms, which, as the disc, B, revolves, take up, each one, a small quantity of seed from the case, dropping it, at the upper portion of the revolution, into the hopper, E, whence it flows down through a pipe formed in the centre of the coulter or plough, F. The disc-shaft carries, outside the seed-case, a pulley, or flanged wheel, G, fitted with a small winch-handle, for the winding on of the actuating cord.

Fig. 1.



In using the implement, a quantity of line is wound upon the pulley, and the loose end is attached to some fixed point on one side of the bed, or division of ground to be drilled. It is then drawn forward by the handle, H, shown broken; and as the coulter, F, produces the furrow-drill, the unwinding of the line causes the disc, B, to revolve, and each cup lifts up and deposits its quantum of seed in the hopper of the coulter, to be carried directly to the newly-formed furrow. To guide the seed properly into the cups, inclined pieces, I I, are employed. These are fast to the disc, B, and, in their revolution, they sweep the seed into the cups.

Fig. 2.

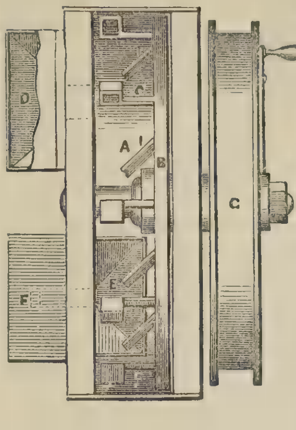
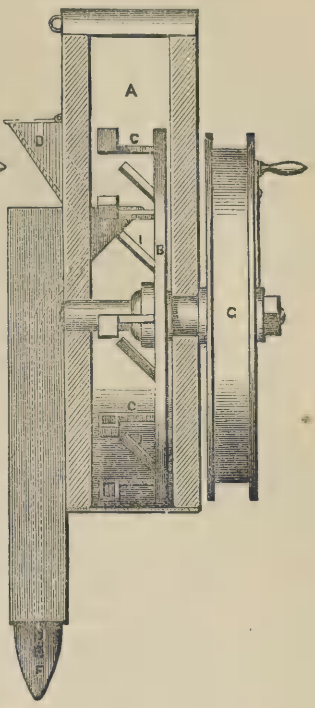


Fig. 3.



The novelty in the arrangement consists in the case, A; the cups, C; the pulley, G; the handle, H; and the inclined guides, I.

RECENT PATENTS.

LUBRICATION.—W. Little, *London.—Enrolled Oct.* 16, 1849.

Mr. Little takes petroleum as the basis of a lubricating medium. He distils petroleum, and the first product coming over, he applies to purposes of lighting, the more greasy secondary product being that intended for lubrication. In manufacturing a lubricating substance, 32 parts by weight of tallow, and 75 parts of soda ley, of from 10° to 11° Beaumé, are boiled together; subsequently adding 29 parts of water, and again bringing the compound to the boiling point. It is then mixed with 45 parts of the greasy products of petroleum, with which it is thoroughly incorporated; when cooled down, it is ready for use. If greater fluidity is required, the more fluid portions of the oily petrolean products, which first come over, are boiled with 10 per cent. of soda ley, until a thick white vapour appears; it is then cooled down for use.

The Claim is a general one for the use of the products of petroleum.

LUBRICATION.—A. Munkittrich, *Manchester.*
Enrolled Nov. 1, 1849.

Mr. Munkittrich's improvements in lubrication refer to a new compound, or mixture, intended as a substitute for oil, or the various compositions now applied to lubricate the rubbing surfaces of machinery. It consists of 4 lbs. of any suitable solution of caoutchouc, 1 lb. of glue, 10 lbs. of carbonate of soda, 10 gallons of animal or vegetable oil, and 10 gallons of water, in combination. In mixing these ingredients, the water is first boiled, and the carbonate of soda and glue are dissolved therein, afterwards adding the oil and caoutchouc, stirring and mingling the whole well together, until it becomes homogeneous, and of an oil-like fluidity.

The patentee Claims the combination of these ingredients, or of like substances, which may be used as a substitute for oil in lubricating machinery, or for other purposes.

FINISHING WOVEN FABRICS.—Malcolm Macfarlan, *Glasgow.*

Enrolled November 29, 1849.

Mr. Macfarlan's invention, which we shall also shortly describe, and illustrate with full drawings, refers to certain arrangements for the production of what is known as the "elastic finish," and which are confined principally to a peculiar finishing cylinder, fitted with traversing laths or spokes, over which the fabric is passed at right angles in the process of finishing. This cylinder is so contrived, that as opposing angular movements are given to the cloth in passing over the laths, its diameter shall diminish at the instant that the angular stretch comes upon the fabric, tending to shorten its actual rectilineal dimensions.

The patentee proposes various modifications by which his plans may be carried out, either by flat or cylindrical surfaces, which we shall hereafter fully describe.

REVIEWS OF NEW BOOKS.

Report of the Art-Union of Glasgow, for the Year 1848–9.

This Report has lain on our table from month to month for lack of room to notice it even in the briefest manner; and, even now, the campaign of scientific meetings leaves us space for little more than a mere acknowledgment of its existence. We gather from the statement of the committee of management, that, during the two years preceding the appearance of their Report, the largest sum paid for any one painting was £40; and that, consequently, they had, up to that time, been able to hold out but slight encouragement to artists of standing. This drawback has been remedied by more liberal purchases; and, amongst others, "Christ bearing his Cross," by Mr. Noel Paton, has been secured.

As an example of what is doing in the issue of prints, the Report before us bears, as its frontispiece, a tolerably well-executed plate—on a small scale, 5 inches by 4—of "Whittington listening to the sound of Bow Bells," the large plate of which, in the line style, 13½ inches by 11½ inches, engraved by T. A. Prior, from the painting by F. Newenham, is being now proceeded with for distribution next year. The hero is represented reclining with his elbow on a mile-stone, listening to the far-off sound which has suddenly inspired him with the thought, and, with that thought, the conscious feeling, that he should one day become an illustrious man. It is most satisfactorily treated. The other print is a lithograph of Phillips' painting of "Highland Courtship." Its size is 12½ by 10 inches; and it is here represented in an oval, on tinted paper, from the lithographic press of Messrs. Maclure and Macdonald. There is a heavy coarseness about this production which we do not like; but it is, perhaps, hardly fair to prejudge it from this miniature lithograph.

The number of paintings allotted this year is 24, ranging in price from £120 downwards; and, in addition to these, a few extra prizes were given in the shape of half a dozen casts of a statuette, the "Wayside Flower," by Mr. Mossman, a local sculptor of talent. To these were added thirty India proofs before letters, of "May Morning," the engraving for the present year. All considered, we have to report a very considerable improvement in the selection of prize subjects; and the public appear to be of the same opinion, as the subscribers are now 1,205, being an increase of 400 since last year.

CORRESPONDENCE.

IMPROVEMENTS IN POWER-LOOMS.

It is well known to all manufacturers that, in effecting a change from light to heavy goods, or *vice versa*, great difficulties are frequently experienced in reference to the "taking-up" action of the loom. Much attention has therefore been devoted to this portion of loom mechanism, with the view of modifying it to suit for several varieties of fabrics; and amongst the rest, an ingenious arrangement was invented and patented, a year or two ago, by Mr. T. Noton, of the well-known Deanston Works, in Perthshire.

In place of the usual emery rollers, Mr. Noton has introduced parallel disc plates, acting by friction, so as to produce the requisite rotation of the cloth-beam; and his arrangement has been found to answer most efficiently in weaving both light and heavy cloths with the same motion. The emery roller, on the other hand, although the best contrivance yet adopted for light cloths, is found quite unequal to the task of taking up a heavier kind. The friction discs act in concert with the emery roller, being placed at the end of the cloth-beam. One of them is worked loose on a pivot, being turned by the ordinary gearing of the taking-up motion; and the friction is adjustable by nuts, so as to take up the cloth as fast as it is delivered from the emery roller, giving at the same time whatever tension is required for the cloth during the operation of weaving. To effect this object, the cloth-beam must be removed to such a distance from the emery roller as to allow sufficient room for any length of cloth that may be required to be wound on the beam, without its touching the roller.

The cloth passes over the roller as formerly, therefore its thickness or shotting is regulated by it; but the friction-plate winding-on arrangement supplies the important desideratum of an easily adjustable tension for any class of fabrics.

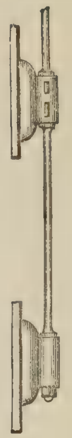
Its value is now becoming known amongst the British manufacturers, as well as our neighbours on the Continent; and at the Deanston Works several hundred looms have been at work ever since the date of the patent. T.

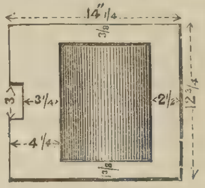
November, 1849.

STEAM-ENGINE SLIDE-VALVES AND STONE-FLOATS.

In a pair of 12-horse engines, lately erected in this town, on the high pressure condensing principle, we have had a deal of trouble with the valves, owing to their wearing the facings, and making a very disagreeable noise when working. Having noticed the wear, we applied oil cups without effect; indeed, it increased the noise, and caused the valve gear to work very uneasily—in one instance, to cause a stoppage, from breaking the ring in which the cam revolves. We employed melted tallow to lubricate the valves, which are of the size and shape here given.

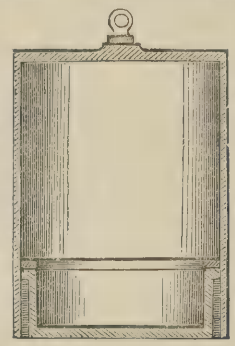
The valves are of iron, working against brass facings riveted on the cylinder-flange. The steam is 22 lbs. pressure, and the vacuum will average 13 lbs. on the square inch. They are worked by Varley's Expansion Motion, and cut off at $\frac{1}{6}$th. By allowing this a place in your pages as early as convenient, it may perhaps meet the eye of some of your correspondents, able to give a little information on the subject, and you will greatly oblige the writer.





You will remember that, on July 31, 1848, I applied to you on the subject of corrosion of stone-floats in steam-boilers. I now have to inform you, that since that time I have adopted the following plan, which, in every case, gives satisfaction. I employ a cast-iron cylinder, with the end made up by a shell, which is jointed with cement in the usual way, of the size and shape as here given.

This idea may possibly render assistance to others, as I am not aware of its having been applied anywhere before.



B. S. Haworth.

Burnley, Oct. 10, 1849.

ON DORMANT WATER-POWER.

The subject of steam-power so far occupies the attention of our mechanics, that water-power is almost entirely thrown into the shade; but I beg to suggest, that it were much to be wished that the readers of your excellent journal, at least, should not have to complain of lack of information on so important a subject.

This desideratum is, it is to be hoped, now about to be supplied; and the appearance, in Parts XIX. and XX. of your publication, of a valuable article on "Water-Wheels with Ventilated Buckets, by W. Fairbairn, C.E.," may, I trust, be looked upon as an earnest of what may be expected on that subject in future. The perusal of that communication is well calculated to beget a desire for further information on water-wheels generally, from so high an authority as Mr. Fairbairn; and could he, or any other eminent engineer, be induced to publish a treatise on the subject, it would, undoubtedly, be highly esteemed by all practical mechanics. Now, in such a treatise, what may be termed the dormant water-power of the country, might naturally enough be incidentally discussed. It might be shown that the loss from this source does not altogether arise from ignorance of the best modes of applying it, but is to be ascribed, in a great measure, to the very great natural irregularity in the flow of our mill-streams, which results from the want of proper reservoirs. The genius of our mechanics has done much to render available what comes within their immediate province, but something more is required before the water-power of the country can be said to be fully within its reach. The law of entail should be so altered as to allow proprietors to sell, or grant, very long leases of lands suitable for reservoirs, in order that parties might feel justified in making the large outlay necessary for their construction. It may be remarked, that had this defect in the law been sooner attended to, many social, as well as economical, advantages would have followed, for the manufacturing population might have grown up in detached spots over the country, as in America, in place of being cooped up in a few towns situated near the great coal-fields. But to return to hydrodynamics, I beg to call the attention of contributors to your excellent periodical, to the following practical problems, which, independently of the material employed, embrace the most important points where correct information is to be desired in the construction of water-wheels.

Given the height of fall, and average quantity of water: Required—1. Diameter of wheel. 2. Width of ditto. 3. Depth of shrouding. 4. Number of buckets. 5. Best form of ditto. 6. Velocity of wheel. 7. Form of teeth of ditto, spur, bevel, or converging. 8. Best point for taking power from wheel.

In conclusion, I would further suggest, that a comparison of the respective merits of Whitelaw and Stirrat's patent improved Barker's mill, and the turbine-wheel, with the common overshot, might usefully occupy some of your valuable space.

Edinburgh, Oct. 20, 1849. C. D.

[It is quite true, as our correspondent observes, that the steam-engine has, to a great extent, elbowed off a due consideration of the advantages to be derived from the employment of water-power; but he must allow that this is quite reasonable, for in the majority of cases the steam-engine is by far the most convenient mover. There are yet, however, many localities where water might be economically applied as an assistant to manual labour; and to bring such quarters to feel the advantages of its inert stores, such information as our correspondent has touched upon is essentially requisite. Any of our readers who can render us assistance in this way, might perhaps be worse employed than in giving us their experiences.—Ed. P. M. J.]

HEATON'S METHOD OF PREVENTING THE OSCILLATION OF LOCOMOTIVE ENGINES.

I shall feel obliged if you will allow a small space in your valuable Journal for December next, in reply to remarks, page 145, October, 1849, on my paper and model, read and explained before Section G, at the meeting of the British Association at Birmingham, on Friday, 14th September, "On the Cause and Prevention of Oscillation in Locomotive Engines." You say, "A serious amount of vibration arises from the unbalanced action of the cranks and pistons, yet *doubt* if it requires such a balancing movement as that proposed." I reply, the weights now fixed in the wheels to balance the cranks, Stevenson's three cylinder engine, Bodmer's double-action or telescope engine, Crampton's, with 8 feet wheels, and short-stroke or slow engines, the broad guage, and many other things, have all been attempts to overcome or prevent the jumping, twisting, or oscillating motion which has always been, and is still, most objectionable; and I ask, seriously, has any of these pro ects succeeded in its object?

The ordinary movement of the working parts of a locomotive bear no comparison with "the model, that being made excessive for the purpose of colouring up the bad effects of the oscillation." A principle is defective which will not bear to be carried to extremes—as slow or fast, small or large. This model shows the principle it professes, carried to extremes, namely, producing steadiness of motion, however quick or slow the movement. The same principle acts on all bodies—a difference in the weight moving, or to be moved, always producing the like effects. The importance of balancing all movements in nature "is old and well known," but when it is stated, "the recommendations this model involves are so old and well known that we are surprised at its being again brought forward to the displacement of novelties of greater importance," I have to challenge you to show what important novelties were displaced, or what engine, principle, or machine, yet known or used, produces steadiness of motion in locomotives at high velocities. You must well know that very many other contrivances, having the same end in view, have been abandoned,—complexity of parts, loss of power, speed, or other objections, being discovered in practice. "Counteracting contrivances," you say, "add to the first cost and friction of the whole." Why, Sir, experiments with this model prove that the friction is reduced more than 15 per cent. when the counteracting contrivances are added, independently of their removing all the violent shaking, jumping, and twisting of every part of the engine, and framing, and rails; and effecting a still further saving in wear and tear, of perhaps 20 per cent. more,—the first cost of the application being very trifling, compared with the advantage secured.

Have we not many times had to deplore fatal accidents arising from unexplained causes, on the best-constructed and straightest parts of the lines of railways—as on the Eastern Counties, the Birmingham and Gloucester at Newton Bridge in October last, and on the North Midland whilst conducting experiments on the guage question, attended by the most talented engineers of the country, and many others; where, at the inquests on the sufferers, no intelligible explanations were or could be given, as to either the cause or remedy? Will you kindly direct me to any work, principle, or machine, which calculates and explains the effect produced by the stopping and starting of weights—whether pistons, wheels, or any other? At high velocities, we know, great effects are produced; that engines go off the rails inside the curve, that a side movement of 6 or 7 inches frequently takes place between engine and tender, when not coupled very tight to prevent it in some measure, but leaving the cause untouched.

This balancing principle has been tried, with precisely the same results on the locomotive as in the model; circumstances, however, entirely unconnected with the value of the principle, have hitherto prevented its general adoption. But I have no doubt whatever, that after some such dreadful accident as those above-named shall have occurred to persons in high quarters—which may Heaven long preserve us from—the value of this compensating principle will be seen, and will be found to produce larger dividends and greater safety to railway companies and the public.

George Heaton.

Birmingham.

[Mr. Heaton, by his lengthened retort upon our remarks in October last, would fain draw us into an extended discussion, which the subject does not deserve. The several schemes adduced by him in support of his opinion of the intense risk which we run by the non-adoption of his plan, require some sifting; for only one of them, the weighted wheels, is to be considered as applied for the purpose in question, and even it is only occasionally adopted. We at once take a decided objection to his doctrine, as elucidated in the words, "a principle is defective which will not bear to be carried to extremes;" and we need not stop to discuss our reasons for so doing, except to point out, that a locomotive wheel, driven at the speed of his model, presents an excellent example of the fallacy of his reasoning. We have to reiterate, that the proposition is "so old and well known that we are surprised at its being again brought forward;" and we say so for the self-evident reason, that it has so often been used as a stock-lecture subject that it has become absolutely tiresome. The sessions of a body like the British Association ought to be marked by the presence of novelties, in place of having their lists encumbered with dry details of what every one knows. Let us be understood. We do not in any way question the efficacy of this balancing movement; but we do question whether or not we require it. It is childish to put down a mass of railway casualties as arising from a want of balance. Like all sweeping assertions, it has no foundation to support it. We do not accept our correspondent's challenge "to show what important novelties were displaced" by his paper, seeing we are not deep in the mysteries of the management of the Section; nor can we reckon up the important subjects which might have come forward, had they not been threatened with an elbowing from those of an inferior class. The absorption of 15 per cent. of the engine's friction, requires a better confirmation than a mere trial with a toy. Can he show a like result upon the regular working stock of a railway?—Ed. P. M. Journal.]

GUTTA PERCHA DRIVING-BANDS IMPROVED.

I believe every one who has tried gutta percha driving-bands will admit that this material is greatly superior to leather for working on cone pulleys, where no band or belt will run long if not nearly straight. The gutta percha being of a uniform thickness and strength throughout, possesses a great superiority over leather in this respect; but it is greatly inferior to leather in its adhesive properties, more especially in damp weather, or in the morning after a damp night. In consequence of its sliding over the pulleys in damp weather, its use here was discontinued. About 13 months ago, I put a thin facing of leather on the side of a gutta percha belt, next the pulleys, whereby I secured the beautiful uniformity of the gutta percha, combined with the adhesion of leather. A belt of this description has been at work about 12 months, and the result of the experiment shows it to be superior to leather or gutta percha alone.

This may be of considerable importance to engine-builders, machine-makers, and others, who have cones on all their machines, and often require more power than the bands will transmit.

Geo. Tosh.

Whitehaven, Oct. 18, 1849.

[In our "Notices to Correspondents" of last month we made mention of this communication, in reference to the fact of our having previously seen compound driving-bands of leather and gutta percha. In the Birmingham Exposition, a set of these bands, of various widths, from 2 inches up to 12, has been deposited by Messrs. Hepburn, of Southwark, London, the patentees of the improvement. The main substance of the belt, gutta percha, is cemented between two thin surfaces of leather, which afford it protection from the effects of friction and heat. Although invented some time ago, these bands have not yet got into general use; therefore, some merit attaches to our correspondent for drawing attention to the improved modification.—Ed. P. M. Journal.]

SHANKS' METHOD OF MOULDING PIPES.

Seeing a notice of my patent in your last Journal,* I beg to correct your remarks there made, and to say, that, by my patent, pipes can be cast any length—in fact, much longer than by any other mode yet in use. I can also cast them much thinner, as I can show to any one that may be interested in such affairs, after my present machine shall have been completed, which will be in a few days.

A. Shanks.

Johnstone, November, 1849.

ON STRAIGHTENING TEMPERED STEEL WORK.

I beg to send you a method of bringing straight thin steel works which have become twisted in the process of tempering. If you think it would be found useful, I shall be glad if you will give it a place in your valuable work.

If, after tempering, the work has got twisted, I heat a piece of iron proportioned to the size of it, and fix it in the vice, and then pass the convex side of the work over the iron in contact with it, until it becomes as warm as the temper will allow of; and to ascertain this, a part must be cleaned on the concave side to show the colour. I then take a wet cloth, and apply it to the convex side to cool it suddenly, and leave the concave side expanded. While the work is heating, and until after the cloth has been applied, the work must be held at the extremities of the curve, and a little pressure given towards the convex side. This process is well suited for delicate works, as it leaves the fine skin unmarked, which would not be the case if the hammer were used.

John Anderson.

East Shore, Newburgh, Fife, Nov. 5, 1849.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF MECHANICAL ENGINEERS.

October 24.

ON THE ECONOMY OF RAILWAY TRANSIT.

By Mr. J. Samuel.

The object of the present paper is to show, that the locomotives now in use on most of the railways have outgrown the wants of the passenger traffic, and that the weight on the driving wheels of these locomotives, amounting in some cases to 14 tons, is perfectly unnecessary for the number of passengers conveyed, in 99 cases out of 100.

For the purpose of obtaining practical data upon this subject, the writer of the present paper procured a return of the number of passengers conveyed on the Eastern Counties and Norfolk Railways, both main line and branches, by each train during the week ending 7th May, 1849; this return showing the greatest number of passengers in each train at any one time.

It appears from this return that the greatest number of passengers in any main line train at any one time was 231, and the least number, 7; the greatest number in any of the branch line trains being 82, and the least number, 3.

And by another return from the books of the Company it appears, that there were conveyed on the Eastern Counties branch lines, during the year 1847, 42,644 tons of passengers (calculating each passenger, with his luggage, at 168 lbs.), and that the weight of engines and carriages required to convey them was about 1,112,500 tons, being in the proportion of 26 to 1.

On examining the coke returns it also appears, that the main line engines consumed from $24\frac{1}{4}$ to $40\frac{1}{2}$ lbs. per mile, and the engines for working the branch line trains consumed from $16\frac{1}{2}$ to $35\frac{1}{2}$ lbs. per mile, varying, of course, with the size of the engine employed to do the work, the smallest engines invariably consuming the smallest quantity of fuel for the same work done. The average consumption of coke during the half year ending 4th July, 1849, was $31\frac{1}{2}$ lbs. per mile for passenger engines, and $47\frac{3}{4}$ lbs. per mile for goods engines.

These returns refer to a stock of about 200 engines, and a length of line of about 310 miles.

Thus the writer came to the conclusion, that it would be possible to construct a carriage and engine combined, of sufficient capacity for branch traffic; and by his advice the Directors of the Eastern Counties Railway gave orders to Mr. Adams to construct such a carriage, subject to the approval of Mr. Hunter, the locomotive superintendent.

The carriage was accordingly built, and called the "Enfield," from the branch which she was intended to work.*

The engine has 8 inch cylinders, and 12 inch stroke; driving wheels 5 feet diameter; distance between centres, 20 feet; width of framing, 8 feet 6 inches. The boiler is of the ordinary locomotive construction, 5 feet long by 2 feet 6 inches diameter. The fire-box is 2 feet $10\frac{1}{2}$ inches, by 2 feet 6 inches.

There are 115 tubes of $1\frac{1}{2}$ inches diameter, and 5 feet 3 inches in length, giving a total of 230 feet heating surface in the tubes. The area of the fire-box is 25 feet, giving a total heating surface of 255 feet.

The weight of this steam carriage is 15 tons 7 cwt. in working trim. The engine and carriage being combined, it is evident that the weight on the driving wheels is increased by the load carried, and that this weight increases in the same ratio as the load required to be taken.

The extreme distance between the centres of the leading and trailing wheels being 20 feet, accounts for the steadiness of this machine; there is indeed no perceptible oscillation when travelling at the highest speed, and this verifies the observation, "that the steadiness of an engine depends not on the position of the driving wheel, but upon the length of the rectangle covered by the wheels." This engine, at the same time daily, traverses curves of 5 or 6 chains radius.

The "Enfield" steam carriage was originally intended to convey 84 passengers, but as it was found that when she was put on as an express train the passengers increased in number, a "North Woolwich" carriage was attached capable of conveying 116 passengers, and also a guard's break van, making provision altogether for 150 passengers, which is now her regular train, taken at the speed of 37 miles per hour.

This engine commenced her regular work about eight months since, and the following return shows the miles run and coke consumed by this engine during the $7\frac{1}{2}$ months regular working from January 29 to September 9, 1849:

14,021	total miles run.
705	hours, running time.
1,457	ditto, standing time.
2,162	total hours in steam.
743	cwt. coke consumed in running.
408	cwt. ditto standing.
286	cwt. ditto getting up steam.
1,437	cwt. total coke consumed.

11·48 lbs. per mile average consumption of coke.

The "Enfield" is in steam 15 hours per day, the fire being lighted about six in the morning and drawn at ten at night. But of these 15 hours it appears by the return that she is engaged running only 5 hours, the remaining 10 being employed standing in the siding. It was found by experiment that the quantity of coke consumed standing was 32 lbs. per hour, and after deducting this, and the quantity consumed getting up steam, it will appear that the actual consumption of coke running is under 6 lbs. per mile.

It must also be particularly borne in mind, that this consumption of coke includes the total goods and coal traffic on the branch, amounting to 1410 tons; viz. 169 tons of goods, and 1241 tons of coal.

The "Enfield" steam carriage worked the 10 a.m. passenger train from London to Ely on 14th June, a distance of 72 miles, taking behind her three of the ordinary carriages and two horse-boxes; she arrived at Ely 8 minutes before time, and the total consumption of fuel, including the getting up steam, was found to be $8\frac{3}{4}$ lbs. per mile. The tubes of the boiler are only 5 feet 3 inches in length, and the economy of fuel is consequently scarcely at the maximum.

Another engine, on a similar plan, to couple with a 40 feet carriage, is now nearly ready, the tubes being 6 feet 6 inches long, from which is expected even more economical results.

The result of the writer's experience is the conviction, that for express purposes, and for the larger portion of the branch traffic on railways, the light steam carriage is the best adapted and most economical machine, both as to first cost compared to the work done, and in working expenses.

The repairs of the permanent way are also very much reduced, as may be easily imagined.

The philosophical analysis of the question appears to be as follows: Railways are constructed for the transit of passengers and goods; for the latter, which are capable of division into small parcels, some latitude of form and structure may be allowed; for the former, the stature and properties of man give a fixed standard. The carriage in which men are borne should be lofty enough to permit of standing upright when desired, for comfort to the rich and economy to the poor, as a larger number may be conveyed standing than sitting, in a given space. The height being settled, the *width* must be so proportioned as to exceed the height by nearly one-third, in order to induce steadiness, bearing in mind that in a railway carriage there are two bases, the "spring base" of the frame on the axles, and the "wheel base" of the wheels on the rails. To secure a sufficiently wide "spring base," the axles should be projected beyond the wheels, and in practice a body 9 feet wide may be obtained, where the width of the railway, in centre and side spaces, will permit. But this width being obtained, it becomes essential to get a proportionate length to insure steadiness. Practice has verified this on the Eastern Counties Railway, where for two years past carriages 40 feet long and 9 feet wide, on 8 wheels (30 feet from centre to centre), have been traversing the most difficult curve and gradient in England, the radius at one part being 189 feet.

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* Page 166, for October.

* See our plate and description of this engine in Part IX., Vol. I., for December, 1848.

The largest floor area per wheel—the minimum of dead weight compared with the load and the carriage, with least resistance to traction, is thus attained. The result of this is, that the minimum of steam power is required to draw it.

No truth is more certain than that the number of travellers by railway is increased by the facilities given for travelling. If a large engine and train costs a given sum, and the departures are every two hours, supposing that engine and train could be divided into four, and a departure take place every half-hour at no increase of expense, it might be assumed that the passengers would double their numbers; but it may easily be demonstrated that the expense would be lessened, because, by improved arrangement, the total dead weight is much reduced.

On the Eastern Counties Railway, an engine and tender of say 30 tons, a break van, a first class carriage, and three third class carriages, conveying say 120 passengers, make a total weight of 59 tons, and the consumption of coke, as has been already shown, is, on the average, 34 lbs. per mile. A steam carriage weighing only 17 tons will transport the same number of passengers at from 7 to 8 lbs. of coke per mile, when the best proportions are attained.

The first cost of a large engine, tender, and four carriages, has been £4000. The steam carriage for the same number can be made for something less than one-half the cost.

The value of the railroad in lessening draught consists in its perfect horizontal level, and not merely its general level, but its close approximation to the nature of a lathe-bed—a hard, inflexible, smooth, true, and equable surface.

With heavy engines, having 5 tons weight or more on each driving wheel, it is impracticable to maintain any road that it is possible to construct in this condition; for supposing the timbering to be of sufficient surface, and the rails to be perfectly inflexible girders, with their joints unyielding, the very iron itself will abrade beneath the tread of so heavily-loaded a driving wheel, which, whether of 8 feet or of 30 feet diameter, can only rest upon a mere point.

It is a matter of doubt whether more than 3 tons can be placed on a wheel at great speeds without destroying the metal.

But there is yet another question to consider. In order to start a train into motion a great amount of power is necessary, many times greater than that which is requisite to keep up motion.

This surplus power remains in the train under the name of momentum; and it must be obvious that the greater the total weight of the train, the greater must be the momentum. If the road be in bad condition, with loose joints, the momentum essential to the maintaining of motion is consequently absorbed by these concussions. In short, the joints are a series of holes, and many of our railways, relatively to the heavy engines traversing them, are practically worse roads than a well-made macadamised road is to a stage coach.

If thus the weights be reduced below the point which causes destruction, it is probable that the heavy item called "maintenance of way," and the still heavier item of displacement of rails, chairs, and sleepers, will nearly disappear.

Mr. Samuel further explained the diagrams illustrating his paper, and remarked that the Fairfield steam carriage, on the Bristol and Exeter Railway, had hitherto been worked with an upright tubular boiler, which had not proved satisfactory, and the regular working of the engine had been prevented by the difficulty in keeping the tubes tight; but a horizontal boiler had been substituted, and the engine was just starting to work with it.*

Mr. M'Connell said, the results given by Mr. Samuel in his paper afforded proof of great economy; but how far this description of miniature engine might be brought into use on railways in general, must be determined by actual experience to a greater extent than was yet afforded. He believed that the branch on which the Enfield engine had been running was as favourable for the trial of the engine as any that could be selected. He had himself had an opportunity of travelling on the engine from London to Enfield, when the performance was very satisfactory for the load conveyed; but any increase of load, or additional amount of traffic, would materially affect the performance of the engine, because, with a just appreciation of economy, it had been balanced as nearly as possible to the load expected. If they could, in the general management of railways, ascertain the exact number of carriages required for the accommodation of the traffic, a great economy of locomotive power might be effected; but unfortunately, in practice, they were often required to provide something like a maximum of power for a minimum of traffic. He had no doubt that the circumstances of many railways, particularly in those districts where the traffic was nearly uniform, would oblige them to adopt a power more nearly corresponding to their wants, and to the loads they had to take; for undoubtedly the power of many engines at present at work far exceeded their real requirements. He agreed with Mr. Samuel, that this extra weight on the rails must materially affect the question of maintaining the permanent way; and as the quantity of coke consumed while standing and getting up the steam are expenses constantly attending all engines, he thought Mr. Samuel was quite justified in taking credit for economy. He was not, however, prepared to say how far this description of engine might be made applicable; but should be very glad to see any effectual step towards economy in the expenditure of railways, and he thought Mr. Samuel deserved great credit for having made such an effort.

As applicable to the subject, he recollected that on the Birmingham and Gloucester Railway it was found desirable to employ an economical power for the purposes of traffic on the small branch line from the main line to Tewkesbury, and for this purpose he adapted one of the small American engines, by combining the engine and tender on one frame, and by putting a tank on the top of the boiler. But the gradients were very abrupt coming out from Tewkesbury, and when they worked the goods and passenger traffic together they were frequently obliged to increase the number of carriages, and in some cases the power was insufficient. The engine had $10\frac{1}{2}$ inch cylinders, with 4 feet driving wheels, and 20 inch stroke; the consumption of coke was from 15 to 17 lbs. per mile; and the gradients varied from 1 in 300 to 1 in 80. The pressure, however, on the American engines was very fallacious, for the spring balance only indicated about one-third of the actual pressure on the boiler, which was really about 100 lbs. per inch.

Mr. Adams of Birmingham remarked, that the Enfield engine was all on one frame with the carriage; but a different arrangement was adopted in the Cork and Bandon engine, in which the engine and carriage were on separate frames; and he inquired the reason for adopting the former plan in the Enfield.

Mr. Samuel explained, that as the length of coupling of the engine wheels in the Enfield was only 5 feet 4 inches, with an 8 inch cylinder, it was necessary to attach the engine and carriage on one frame, otherwise it would be too short to run steadily. The effect produced by the carriage was like the stick of a rocket in steadying the motion. But in the Cork and Bandon engine, with a 9 inch cylinder, the length of coupling of the wheels was 10 feet, and no carriage was required to produce steadiness, as the rectangle on the rails was so much longer. In the case of large engines, where the distance between the axles had been increased to 16 feet, a greater steadiness was observable.

There was accommodation in the carriage for 15 first class and 116 other passengers, giving a total accommodation for 131 passengers; and this he considered the most serviceable for working the express traffic. One of these steam carriages was being prepared for working on a railway in Scotland, at a contemplated speed of 40 miles an hour. At the present time it was impossible to keep the road in good repair, especially on the old lines, in consequence of the enormous weight of the engines.

He had, with the Enfield engine, made the quickest journey that had ever been performed between Norwich and London. With a train capable of containing 84 passengers, they performed the distance of 126 miles in 3 hours 35 minutes, including stoppages. Another advantage in a large carriage of this description resulted from making use of the side space, for there were only 8 wheels to do the work of 24, and at the same time they had no greater amount of weight on each wheel than under the ordinary arrangement. The whole weight was 9 tons without passengers, and 84 passengers might be taken at an average as weighing 6 tons.

Mr. M'Connell said, that undoubtedly with the present carriages the proportion of the tare to the passengers carried was very great; and although a case which rarely happened, instances had occurred where the tare was 50 tons to 3 tons of passengers. But even taking the weight of passengers at 10 tons, 50 tons of carriages was unquestionably a large proportion of dead weight to carry; and he considered that the long carriage, if always likely to be well employed, would be an advantageous mode of saving the dead weight, more especially on branch lines, and at the junctions where such branches came in.

The Chairman said, they were much indebted to Mr. Samuel for bringing the subject before them; and he only wished that more of their railway friends had attended the meeting, for it was a paper which well merited their deep consideration in the present depressed state of railway interests. The question of economy in the heavy current expenses of railways had for some time occupied his attention; and although he did not go to the full extent with the proposer of this new system, he nevertheless went to a considerable extent with him, and admitted that there were cases of passenger traffic, and branch traffic, and sometimes even short local lines, such as that from London to Greenwich, London to Blackwall, or London to Broxbourne, where the number of short passengers was great, and the number left in long trains was very small, thus causing the train after a certain portion of the journey to work very disadvantageously. He had no doubt that companies would have to classify these trains to a much greater extent than had hitherto been done, and in that case the present plan might be tried with advantage; but he could not go with Mr. Samuel in saying, that an engine so light as he had described was applicable to express travelling.

Even the principle of attaching a carriage to the engine for the purpose of giving adhesion, appeared to him a very doubtful expedient, because small engines were much heavier in proportion to their power than large ones. He considered that Mr. Samuel's arrangement in the case of the Cork and Bandon engine was a good one, but attaching a carriage to an engine was very objectionable; it was like riveting harness to a horse, and could not be desirable under any circumstances whatever. Mr. Samuel did so to increase the weight on his driving wheels, and consequently obtain more adhesion; but he forgot that he had already more weight on the driving wheels than was adequate to drag the carriage along. This was adding more than enough, because an engine that weighs only 5 tons is not so capable of slipping upon the rail as an engine that weighs 30 tons, and therefore attaching a carriage upon the frame of a small engine was superfluous, and the inconvenience arising from having them riveted together, would, in some cases, be exceedingly great, more especially in working a station.

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* This comes back to our own remarks as to the superiority of the horizontal boiler, given in connection with the engraving of the vertical boiler engine, at page 275, Vol. I.

Cases, however, might presently arise which would be favourable to the development of the proposed system. For instance, railways had been laid down where hardly any justification existed for their construction; these must be worked at the least possible cost, and Mr. Samuel's plan might be adopted advantageously. But let not his very useful system be overstrained, because there was no great branch line, express or otherwise, to which it could by possibility be applicable. It would be largely applicable to minor branch lines, but he (the chairman) felt that if he were to allow this paper to be read without saying anything, considering the position which he occupied in the railway world, it would be taken as a tacit acquiescence on his part in the broad principle of applying small engines where, in fact, for a period of nearly 20 years (ever since 1831), they had been doing everything in an opposite direction to that which Mr. Samuel was now pursuing. Hitherto they had been contriving engines to develop railway traffic on the main trunk lines, where not only great despatch, but great comfort, is exacted; and he would ask whether the public would be satisfied to be packed up like fish, ninety in a carriage. That they would not be content with inferior accommodation was sufficiently evident from the eargerness with which, on the arrival at a station, persons made their way to the four inside carriages, which he thought were much more conducive to comfort than the broad guage carriages with eight inside.

SOCIETY OF ARTS.

President—H. R. H. Prince Albert, D.C.L., F.R.S.

May 23, 1849.

"On the Past Progress and Present Artistic Condition of Calico-Printing," by Mr. G. Wallis.

Mr. Wallis stated that calico-printing was first introduced into Great Britain a little prior to the year 1700. The first print-work was established at Richmond, on the banks of the Thames, by a Frenchman; and the establishment of others soon after followed in Sussex and Essex. It was, however, to the extraordinary development of the art of calico-printing in Lancashire to which he desired more particularly to direct attention. The Claytons of Bamber Bridge were generally supposed to have first introduced calico-printing into Lancashire, about 1764. The Peels of Blackburn followed, and from this house arose the Peels of Church Bank and the Peels of Bury. The late Sir Robert Peel was at the head of the latter firm for many years. Other early printers were also named, such as Fieldings of Caterall, and Livesey, Hargreaves & Co. of Mosney, near Preston. One of the first attempts of the elder Peel, now known as "*Peel's parsley-leaf,*" was next alluded to, and illustrated by a diagram; after which Mr. Wallis proceeded to give an epitome of the progress of the various styles, showing how, from the simple white spot on a dark ground, or dark spot on a white ground, have arisen the various combinations of effects now produced. This he illustrated by a series of drawings progressively arranged, from the simple example of the single spot without colour, the double spot, one being coloured, then both coloured by block; to the introduction of colours in combination with white, until the full dark-ground chintz style became progressively and fully developed. Mr. Wallis then described, by means of sketches, the various kinds of blocks; and illustrated the effects produced by *wood-cutting* only, *pin-work*, and *brassing;* as also how the combination of these methods gave increased facilities of production. From about 1790 to 1800, *block-work* appears to have been carried to the greatest perfection for garments. Mr. Wallis then traced out the progress of engraving on metal, as flat plates and copper cylinders, having stated that the first attempt at roller-printing was most probably made by Livesey, Hargreaves & Co., by means of wooden rollers, soon afterwards abandoned for the copper cylinder. The progress of machine-printing from 1801 to the present time, then occupied the attention of the lecturer, and he traced out the progress of styles during that period, confining his attention almost exclusively to garments; furnitures being only named incidentally. He showed, amongst other examples, a sketch of a pattern engraved on a flat plate by the late Mr. Lockett, sen., of Manchester, in 1801, for Fieldings, and a small piece of French muslin of the present season, the two being precisely the same. The small patterns of 1808 he stated to be identical with those now produced in the same styles by the French. After illustrating the relation of the *design* to the requirements of the roller as regards size of "*repeat,*" and showing by diagrams the nature of machine-engraving—of the *die*, *mill*, and *roller*—Mr. Wallis explained how the improvements in machine-engraving and machine-printing had modified the nature of designs as applied to the decoration of calicoes; and that the productions of the style known as "Hoyle's" was dependent for its cheapness and beauty on this method of engraving and process of printing. The nature of *mordants*, *resists*, and *discharges* was also briefly explained in the course of the paper; and the distinctive difference between *madder*, *steam*, and *spirit* colours pointed out. The features of the leading styles of various periods were glanced at, such as Lane's net, Lockett's eccentrics as *covers*, Hoyle's wave, the diorama, the rainbow, &c.; as also the minor distinctive characteristics of the various styles, such as the bird-eye, Bengals, Storment, the worm-pattern, &c., which have obtained public favour during the last fifty years. The paper was illustrated by numerous specimens of calico-prints as well as diagrams; and Mr. Wallis produced at the conclusion some beautiful specimens of printing, both as regards drawing, design, and execution; and showed that ugliness was not a necessity of calico-printing in England, as some people appeared to think.

May 30.

Mr. C. W. Siemens read a paper "On an Improved Electric Telegraph," the invention of his brother, Mr. E. W. Siemens of Berlin, at the meeting of May 30. The paper was illustrated by a series of diagrams, and a pair of the instruments were exhibited at work.

Without reference to figures, it is impossible to describe satisfactorily the beautifully contrived mechanism by which Mr. Siemens' telegraphs work, beyond stating, that the telegraph is a self-acting machine, breaking and restoring the current itself; and when put in motion, it continues to work until stopped, by preventing at any time the restoration of the current. At each end of the line is a dial, with the letters of the alphabet arranged round its face, with pointers like the hands of a clock. These hands revolve contemporaneously at each end of the line; and by pressure on a button opposite to any given letter, the hand stops opposite that letter; whilst at the other station, the hand of the instrument there stops in a similar manner at the same letter. The mode by which this is accomplished is extremely ingenious and accurate. These telegraphs have been in use for upwards of two years with great success on the German lines. One wire only is required, and this, covered with gutta percha, is buried in the earth. This plan has answered admirably. By means of this telegraph the government dispatches are sent; and the speeches of the German parliament at Frankfort have been regularly transmitted to Berlin, and printed the following day at Berlin.

"On the application of Electricity to prevent the Explosion of Steam-engine Boilers," by Mr. A. Dunn. The paper was illustrated by a working model and diagrams.

The principle on which Dunn's thermo-electric telegraph apparatus proceeds is founded on Boutigny's discovery, that the temperature of water may be increased without corresponding development of steam, the water not passing into a vapour, but assuming what is termed the "spherical state;" liable, however, at any moment suddenly to expand into steam, at a pressure due to the high accumulated temperature, producing explosions of the boiler, whilst the ordinary steam-guage exhibits no sign of undue pressure. The object of Mr. Dunn's invention is, to ascertain at all times the *actual temperature* of the water in the boiler; and this he accomplishes by means of the expansion of mercury in a tube so arranged in connection with a galvanic battery, that a bell is rung, or other signal given, at the instant the mercury in the tube has expanded so far as to complete the galvanic circuit. It is obvious that the mercurial tube may be so fixed as to cause the signal to be given at any desired temperature; and having ascertained by experiment the pressure of steam corresponding to any given temperature, he can readily set his apparatus so as to give notice the instant it rises to a given point.

Mr. Dunn detailed the results of various experiments in relation to the temperature of water in the spherical state.

ROYAL SCOTTISH SOCIETY OF ARTS.

June 11, 1849.

The meeting opened with a verbal account of "Mr. Stephen White's Hydro-Carbon Gas," by Dr. Wilson; after which, a paper on a method of Ventilating Coal Mines so as to prevent Explosions from Fire-damp, by Dr. Dunn of Doncaster, was read. Mr. Bryson then gave an account of his "Self-Registering Tidal and Meteorological Clock," described at page 136 of our September part. This was followed by an account of a Glass-Blowing Apparatus, by Mr. William Cooper of Aberdeen, who afterwards described a "New Furnace for Melting Glass."

Two drawings were exhibited—one showing a plan of the new furnace, and another the old plan of furnace now in use.

The author remarks, that owing to the manufacture of glass having been so long chiefly in the hands of monopolists, and coupled with stringent excise restrictions, the principle of the crown and plate glass melting furnaces have undergone little alteration or improvement for the last half century.

During the decomposition of the ingredients used in the manufacture of crown, sheet, and plate glass, the application of heat to the crucibles or pots, by the present system, is defective and objectionable.

The present mode of melting, as shown on the plan, is in a square furnace, with the pots placed at each side, and the fire in the middle of the furnace; the flame and heat acting on one side of the pots, and passing over the top of the pots to the working holes, the furnace being fed at each end.

By this method there is a great waste of fuel and heat, and the heat being more immediately on the side of the pots, the decomposition and fusing of the materials begin at the centre or middle of the pot, and is not carried on regularly, which is the means of causing seed and other defects in the glass metal.

1. By the new method the heat is brought to act on the bottom of the pots, where the decomposition and fusing of the materials ought to commence, uniform and regular in its progress towards the top of the crucible, and by this means expelling more effectually the various gases during the process of melting, which, if retained, are injurious to the metal.

2. The construction of the tease-hole is such, that the carbonaceous matter contained in the fuel is consumed in passing through the grate-room, leaving a solid pure body of heat in the furnace, under and around the pots, and thereby preventing the carbonaceous matter from acting upon and discolouring the metal.

3. From the subdivision of the tease-holes, and the retention of the heat, the metal is fused in a shorter space of time.

"On the Manufacture of Kelp-Glass, and on the best kinds of Glass for Staining and Enamelling." By Mr. William Cooper of Aberdeen.

The author in his communication remarks, that the glass-stainer and enameller is subject to frequent disappointments and losses, owing to the variety and different proportions of ingredients used in the manufacture of glass since the use of kelp was abandoned; each kind requiring a different degree of heat, and producing different results, when passed through the enamelling and staining kilns.

English crown glass stands a greater heat than sheet glass, even although of the same composition, and this is owing to the peculiar method of manufacturing it. Glass made from Orkney kelp produces the most brilliant red colour, and which has a remarkable property of transmitting red rays of light at a great distance, and on that account it is preferred for lighthouses. The French ruby glass, though of a rich and beautiful colour, has not the same reflecting power. The author gives the following recipe for making kelp glass for staining purposes, as successfully practised by him for a number of years:—"Good Orkney kelp well ground and sifted, 308; Lynn sand, 224=532 pounds, well fritted together in the calcar arch; a due mixture of cullet to be added while founding. If it is required to improve the colour, reduce the 532 pounds to powder, and add manganese 2 to 4, nitre 8, and arsenic 4 pounds. The whole to be intimately mixed before founding. Cullet may be added or not at the discretion of the founder. If properly treated, either mixture will be found to produce an excellent red colour in crown or sheet glass, by means of the oxides of silver and antimony, in the usual way of applying them."

The author states that kelp is now almost entirely out of use in glass-making; and that a spurious article is now made to resemble kelp glass in appearance, called "dark sheet glass," and sold at double price, as kelp glass. It is made from sand, chalk, common sea salt, and broken glass, and sometimes the usual sheet glass metal is tinged with the oxides of iron and manganese, or smithy coals, to counterfeit kelp glass. This "dark sheet glass," when the staining magma is applied to it, gives a "dingy red colour" with a slow heat; but when fired with other colours, with a smart heat, it produces an "opaque brown colour," instead of the brilliant transparent red expected, and the artist's work is spoiled beyond all remedy.

The author states that Orkney kelp glass is the best for ornamental work and picture subjects, where a brilliant red colour is required, and that the market sheet glass, made with soda, ash, or baryles, &c., and selected as colourless as possible, is the best for enamelling purposes, or for light orange, yellow, and lemon stain colours.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE—NINETEENTH MEETING.—Birmingham, Sept. 12, 1849.

Section B.—Chemistry, including its Applications to Agriculture and the Arts.

"Researches on the Theory of the principal Phenomena of Photography in the Daguerreotype Process," by A. Claudet.—The various subjects treated by Mr. Claudet were the following:—1st. What is the action of light on the sensitive coating? 2nd. How does the mercurial vapour produce the daguerreotype image? 3rd. Which are the particular rays of light that impart to the chemical surface the affinity for mercury? 4th. What is the cause of the difference in achromatic lenses between the visual and photogenic foci?—why do they constantly vary? 5th. What are the means of measuring the photogenic rays, and of finding the true focus at which they produce the image? Light produces two different effects on the daguerreotype plate, capable of giving an image. By one the surface is decomposed and the silver is precipitated as a white powder,—this action is very slow. By the other, the parts affected by light receive an affinity for the mercurial vapour, and this metal is deposited in white crystals. This action, which is the cause of the daguerreotype image, is 3,000 times more rapid than that producing the decomposition of the surface. After having examined the phenomena of these two actions, Mr. Claudet considers that it is impossible to refer them to the same cause. The first is a chemical decomposition of the surface,—and the second is a mere new property imparted to the surface to attract the vapour of mercury, which is given by some particular rays, and withdrawn by some other rays. The most refrangible rays produce the affinity for mercury, and the less refrangible withdraw it. Mr. Claudet afterwards explained the principle of his photographometer, and several improvements he has lately made in that instrument, by which he can compose upon the same plate a series of intensities in a geometrical progression, varying from 1 to 512,—and when employing two plates at the same moment from 1 to 8192; and by another modification of the instrument he can, by shutting one-half of every hole through which the light has affected the plate, and submitting this half to radiation through red, orange, or yellow glasses, he can study the modifications produced on the various intensities of effect by their coloured or insulated radiation. The experiments to which Mr. Claudet refers would be too long to enumerate here; and we shall conclude by alluding to the most important point of this paper,—which is the question of the difference between the visual and photogenic foci, and the constant variations which they undergo by the influence of unknown causes, at all events, which he has not been able to ascertain. It is known that several years ago Mr. Claudet was the first to point out the difference between the two foci, and the necessity for the operator to place exactly the plate at the point where the photogenic focus is produced in order to have a correct daguerreotype image. But the new important fact lately observed by Mr. Claudet refers to the constant variation between the proportionate distance of these two foci. It appears that, according to some causes which Mr. Claudet has not been yet able to discover, the two foci for the same distance of an object are sometimes coinciding and sometimes very far one from the other; and what is most remarkable is, that the difference varies according to some properties of the lenses, in such a manner that when the two foci coincide in some lenses they may be very much separated in the other.

"Inquiries on some Modifications in the Colouring of Glass by Metallic Oxides," by M. G. Bontemps.—In this communication some important practical points connected with the coloured ornamentation of glass and porcelain were brought forward. In the first place it was shown that all the colours of the prismatic spectrum might be given to glass by the use of the oxide of iron in varying proportions and by the agency of different degrees of heat,—the conclusion of the author being that all the colours are produced in their natural disposition in proportion as you increase the temperature. Similar phenomena were observed with the oxide of manganese. Manganese is employed to give a pink or purple tint to glass, and also to neutralize the slight green given by iron and carbon to glass in its manufacture. If the glass coloured by manganese remains too long in the melting-pot or the annealing-kiln, the *purple* tint turns first to a light *brownish red*, then to *yellow*, and afterwards to *green*. White glass in which a small proportion of manganese has been used is liable to become light yellow by exposure to luminous power. This oxide is also in certain window glass disposed to turn pink or purple under the action of the sun's rays. M. Bontemps has found that similar changes take place in the annealing oven. He has determined, by experiments made by him on polyzonal lenses for M. Fresnel, that light is the agent producing the change mentioned; and the author expresses a doubt whether any change in the oxidization of the metal will explain the photogenic effect. A series of chromatic changes of a similar character were observed with the oxides of copper; the colours being in like manner regulated by the heat to which the glass was exposed. It was found that silver, although with less intensity, exhibited the same phenomena; and gold, although usually employed for the purpose of imparting varieties of red, was found by varying degrees of heating at a high temperature and recasting several times to give a great many tints, varying from blue to pink, red, opaque yellow, and green. Charcoal in excess in a mixture of silica-alkaline glass gives a yellow colour, which is not so bright as the yellow from silver,—and this yellow colour may be turned to a dark red by a second fire. The author is disposed to refer these chromatic changes to some modifications of the composing particles, rather than to any chemical changes in the materials employed.

Dr. Faraday spoke on the importance in all our inquiries of associating physical and chemical science. In the beautiful facts brought forward by M. Bontemps, it appeared that many of the changes of colour mentioned are purely physical. The phenomena of the change of manganese from white to pink in glass appeared to him inexplicable as a chemical effect.—Mr. Dilke inquired upon what peculiarity depended the differences discovered to exist in the coloured glass of the windows of old churches and that of modern manufacture.—M. Bontemps stated that the observed differences were entirely due to age and imperfections in manufacture.—Dr. Faraday remarked, that any irregularities tended to produce the diffusion of the rays which permeate the glass, and that the opacity of ancient church windows was probably due to a superficial change of the external surface.—M. Bontemps stated that old glass was, by repolishing, rendered as transparent as any modern glass.

Section D.—Natural History, including Physiology.

A valuable communication was made by Mrs. Whitby, on the progress of the silk culture in England. Her letter, which we give in full, will be read with interest by all who are at all acquainted with the exertions made by her for the propagation of the manufacture here:—

"Birmingham (Newlands).

"I had proposed offering to the British Association a short account of my progress in the art of cultivating silk in England; but I left Newlands before all the produce of this year could be wound off from the cocoon; and it will not, therefore, be in my power to make my report as full, or as statistical, as I could desire. I am, however, unwilling that this meeting should pass, without endeavouring in some way to satisfy the expectations of those who have been sufficiently liberal to pay regard to my convictions, that the cultivation of silk may, with little trouble or expense, be made general, and in the end become a profitable speculation. From the period when I had the honour to place before you an account of my early trials, I have paid attention to the cultivation of the mulberry, especially of that species which I introduced in 1846, viz., the *Morus multicaulis* of the Philippine Islands. I have three other kinds of white mulberry, which all grow well at Newlands; but as none are so easily propagated as the *multicaulis*, or bear so great a weight of leaf, I have increased my plantation with them chiefly. I said, in my letter to the Royal Agricultural Society, in 1844, that it was as easy to do so as to propagate the willow. I now say, that it is much easier, and the produce is more abundant. The produce of leaf this year has been immense, and even now, after having plucked them closely to feed my silkworms, they are strong and vigorous, and present a luxuriance of growth scarcely to be credited—unseen. I find the cuttings which are rooted in the open ground produce stronger and healthier plants than those struck under glass. One of my early pupils has a productive nursery at Godalming of the *Morus alba*—many others in different parts of England are planting; and if gentlemen in England and Ireland who have a few acres or roods of land to spare, would plant mulberries for posterity as they do their oaks, we should, in a few years, be independent of other countries for our supply of raw silk. With regard to the rearing of the silkworm, as their habits become more practically known to me, I find less and less difficulty in bringing them to perfection; and am confirmed in my belief, that, with due attention to their peculiarities, they may be reared in England as easily as in any other country, and with as little loss by death. Equable warmth throughout the period of their existence (which may be shortened or prolonged at pleasure), cleanliness, classification, and ventilation, with the adaptation of the food (as to its maturity) to the different ages of the insect, will insure success. I have been this season very successful in rearing the worms I was able to hatch; they had no disease of any kind—they made their cocoon in thirty days, and the silk I have been able to wind off is as strong, and bright, and beautiful, as that which, in 1844 and 1845, was pronounced superior to the best Italian raw silk. There are many persons in England, and a few in Ireland, who have begun the experiment on a small scale. It requires time to mature and perfect any undertaking; but, if I live long enough, and the growth of the mulberry becomes generally encouraged, I have no doubt my ardent wish to see the cultivation of silk established in England will be realized.

" M. S. S. Whitby."

Section G.—Mechanical Science.

President—Mr. R. Stephenson, M.P.
Vice-Presidents—Messrs. W. Blake, W. Fairbairn, F. Osler, and T. Webster.
Secretaries—Messrs. W. P. Marshall, C. Manby.

Committee—Messrs. J. G. Appold, W. Baker, R. Davison, C. Fox, J. Henderson, E. Hodgkinson, Rev. S. King, Messrs. J. G. M'Connell, R. Martineau, G. Nasmyth, R. S. Newall, R. Roberts, J. Taylor, F. Whishaw.

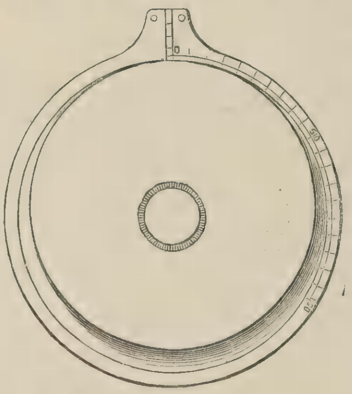
"On a Method of supplying the Boilers of Steam-Engines with water," by Mr. W. S. Ward.—In this arrangement, Mr. Ward proposes to employ a supplementary pumping engine, having a working cylinder with valves so arranged that the piston may be put in motion by either steam or water passing through it, to be supplied with steam by a steam-pipe, the entrance to which is somewhat narrow, and inserted in the boiler to be supplied a little above the level at which it is desired to maintain the water therein. Such aperture should also be about the centre of a marine boiler. The working cylinder should be attached to a pump of such size as to be easily worked by the pressure of the steam. The exit pipe of the steam-cylinder must communicate with the inlet pipe of the pump, so that, if the cylinder be actuated by steam, the steam will be condensed, and its heat communicated to the water to be supplied to the boiler; or, if the working cylinder be worked by water proceeding from the boiler, a considerable part of such hot water will be returned by the pump. The mode of operation of such apparatus will be, that whenever there is a working pressure of steam in the boiler, the apparatus will be in action; but if the level of the water be below the aperture of the small steam-pipe, the action will be moderately rapid, and a supply of water be pumped into the boiler; and when the water in the boiler rises to the aperture, this being small, will be as though choked by the water, which will be forced through the working cylinder, moving the piston and pump very slowly; a portion of the water thus escaping from the boiler will be returned by the pump. Such last-mentioned action cannot continue long, inasmuch as the level of the water must be reduced; therefore the average level of the water in the boiler will be, with slight oscillations, maintained at the height of the supply-pipe.

In the course of a brief discussion which followed, Mr. Roberts stated, that the principle had been applied more than thirty years, and he considered that many plans in use, especially that whereby the principle of gravity was made available, was sufficient for the purpose.

The President observed, that, at a certain point, the pipe leading to the cylinder would admit water mixed with steam. This was an insuperable objection, inasmuch as the admission of such a mixture into the working parts of an engine led to breakage. When the water got between the clack and the bucket it was almost impossible to work the pump. This was manifest in the difficulty experienced in supplying locomotives. In some of the earlier engines it was customary to fill the boilers as full as they could hold, run them as long as possible, and stop to take in a new supply of hot water directly into the boiler. His father, the late George Stephenson, obviated this difficulty by introducing a cock between the bucket and clack, which, from its office of humouring the action of the machinery, was called the "pet tap." He was afraid that the suggestion of Mr. Ward was not practically useful.

In the ensuing discussion, the President remarked that it was a novel and ingenious idea, but hardly suited for practice.

"On an Eccentric Sheet-Metal and Wire-Guage," by Mr. Richard Roberts.—This guage consists of a plate of brass about $4\frac{5}{8}$ inches diameter, and $\frac{1}{4}$ inch thick, recessed on the upper side to the depth of $\frac{1}{8}$ inch, and 4 inches diameter, leaving a margin $\frac{5}{16}$ inch broad, as in our engraving. In the centre of the recess is a hole, into which is fitted a steel pivot whose upper end is riveted into a steel disc 3·8 inches diameter, and $\frac{1}{16}$ inch thick; the pivot is eccentric to the disc $\frac{1}{16}$th of an inch, and consequently one point in the periphery of the disc touches the inner edge of the brass margin, with which the top of the disc is level. To the under side of the brass plate a small slide is fitted, to the outer end of which a piece of steel is attached (by screws), that passes up through a notch in the brass margin about half an inch, and forms the inner or sliding jaw of the guage. The outer jaw is formed of a similar piece of steel also passed through the notch in the brass margin, and is secured to the brass plate by screws. The inner edge of the sliding jaw is rounded to a radius of $\frac{1}{16}$ inch, and is kept in contact with the periphery of the eccentric disc by a spring (under the disc), which acts against a stud in the slide projecting through the brass plate. The margin of the brass plate is divided through one-fourth of its circumference, commencing at the centre of the sliding jaw, into 75 equal parts, which are numbered decimally. The extremity of the disc is then set at zero on the scale, and the jaws accurately adjusted to touch each other, after which the extremity of the disc is turned to the fifth division, and a line is made on the disc to correspond with zero on the scale, at which point the jaws will be opened a little. The disc is turned to the required guage *number* by means of a milled button, or by two studs, and is fixed there by a milled nut on the end of the pivot below.



It may be convenient to have the *numbers* extended from 75 on a fourth of the circumference, and to 100 on a third, but the law of increase in the figures beyond 75 would be reversed. It will be obvious that guages having different *numbers* and dimensions may be more suitable for certain descriptions of work, and likewise that the eccentric principle may be applied to guages in many various ways.

This guage possesses the following properties:—

1st. A corresponding guage may be made, without expensive tools, from a written description of the means employed to make the original.

2d. It admits of accurate construction and easy readjustment.

3d. Each succeeding *number* being larger than the preceding in a progressively increasing ratio, adapts the guage equally well for high and low *numbers*.

"On Chain-Pipes for Sub-Aqueous Telegraphs," by Mr. Whishaw.—Three links of a full-sized pipe for enclosing the wires of electric telegraphs in crossing rivers, &c., were laid before the Section. As the title implies, the pipe is formed by so many links connected together by sockets—each link varies according to circumstances from 18 inches to 24 inches in length, and from 1 inch to $2\frac{1}{2}$ inches internal diameter, according to the number of wires to be enclosed. These pipes being of wrought-iron are exceedingly strong, and are required merely as a protection to the wires, which are previously insulated by means of gutta percha. Pipes of somewhat similar construction are laid under the Rhine and other rivers in Prussia, where the underground system of telegraphs is adopted by the Prussian Government (already to the extent of 1,200 miles), although many of the railway companies suspend the wires between posts, as practised in England, America, France, &c.—The discussion which followed was brief; its purport was generally to signify approbation of the invention.

"On a Tide-winding Apparatus for Clocks," by Mr. R. Roberts.—In this arrangement the inventor has ingeniously turned to account the periodical rising and falling of the tide for winding up clocks, or raising heavy bodies. Our engravings, figs. 1, 2, and 3, represent the apparatus in different views. C, Is a weight raised twice by every tide, in the following manner;—M and N, are chain wheels, placed loose on the shaft, K, and provided with studs on their peripheries, to prevent the chain, *k*, from slipping; P, is a pulley placed on a stud in the framing, under which pulley the chain, *k*, also passes; A, is a hollow weight which ascends and descends with the tide, and B, is a counter-weight, heavy enough to hoist the weight, C, and preserve the tension of the chain, *k*, whilst the tide is rising, the hollow weight, A, being sufficiently heavy to hoist the weights, B and C, during the ebbing of the tide. Whilst the hollow weight, A, is rising with the tide in the tank, R, the pulley, N, which is loose upon the shaft, K, rotates in the direction of the arrow in fig. 3, and carries with it ratchet-clicks over the teeth of the wheel, *p*, whilst the chain, *k*, passing from the hollow weight, A, over the pulley, N, under the pulley, P, and over the pulley, M, to the weight, B, allows the weight, B, to descend: and the clicks placed upon the pulley, M, by operating upon a ratchet wheel, *o*, effect the rotation of the shaft, K, in the direction of the arrow in fig. 2. The weight, C, operates upon the shaft, L, which is in connection with the clockwork, or other mechanism, in the following manner:—G, Is a pulley made fast upon the shaft, L, and furnished with suitable projections on its periphery for preventing the endless chain, *l*, from slipping; H, is a pulley also provided with projections similar to those on the pulley, G; and I is a ratchet wheel, fixed, with the wheel, H, on the shaft, K. The ratchet wheel, I, with its click, are only used when the works

Fig. 1.

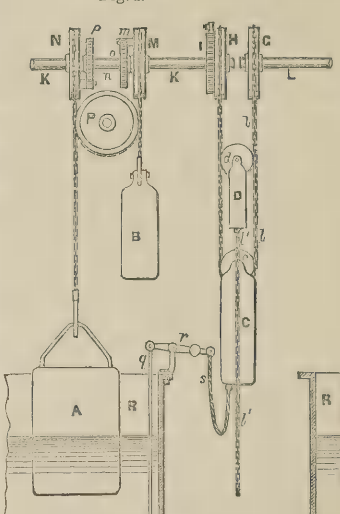


Fig. 2.

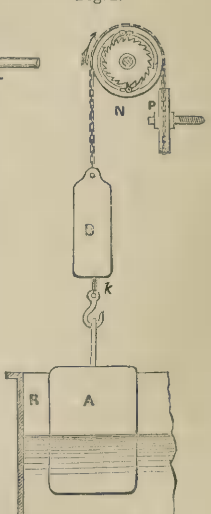
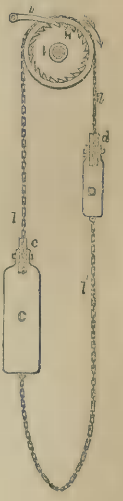


Fig. 3.



are being put together. The endless chain, *l*, *l*, passes over the pulleys, G and H, and is kept in close contact with them by the weight, C, and counter-weight suspended from it by the pulleys, *c* and *d*. During the ebbing of the tide, and consequent descent of the hollow weight, A, the weights B and C are made to ascend, and the counter-weight, D, to descend in a corresponding ratio. During both changes of the tide, the weight, C, descends, and maintains, by its gravitation, the motion of the clock-work or other mechanism to which it is connected, until the influx or eflux of the tide rewinds it as before described. As the endless chain, L, cannot slip upon the pulley, G, the rotation of the shaft, L, will be maintained continuously in the same direction. The effect of the weight, C, upon the clock-work or other machinery, is rendered equimotive by the chain, *l*, which is attached at its extremities to the weight, C, and the counter-weight, D, and extends downwards lower than the weight, C, consequently, as the weight, C, ascends or descends, the weight of chain is diminished as much at one end of the weight as it is increased at the other.

On the ebbing of the tide, the hollow weight, A, descends, and the clicks, *n*, *n*, acting upon the ratchet wheel, *p*, effect the rotation of the shaft, K, in the direction of the arrow in fig. 3.

The advantages of this arrangement are, that whether the hollow weight, A, is ascending or descending, the rotation of the shaft, K, is invariably in the same direction.

As the levels of high and low water will vary considerably at different seasons, it is evident that some limitation of the height to which spring tides would raise the hollow weight, A, in the tank, R, must be effected, inasmuch as, unless this were done, the ebbing of these tides would cause the weight, C, suspended from the endless chain, *l*, to be overwound. This limitation may be effected in various ways.

MONTHLY NOTES.

Railway Rapacity.—On leaving London the other week by the London and North Western line, we met with an instance of a want of liberality which deserves mention. It appears that the weight of luggage allowed to be taken free by a first-class passenger is 100 lbs., and on submitting ours to the scales it was found to exceed this weight by 60 lbs. On inquiring the amount of extra charge to be levied for the carriage of this 60 lbs., we were told it was 4d. per lb., or, on the box in question, £1. As the same weight could be sent by a steamer for something like half-a-crown, we declined the polite offer of its conveyance at a cost of eight times that amount, and accordingly left it behind. We know nothing of what may or may not be a paying charge for the transmission of luggage or goods alone, but seeing we had paid £3 17s. 6d. for our own carriage, we cannot but deem it an unreasonable imposition to add £1 for the weight in question.

Art, an Accessary in Advertising.—Advertising has often been treated of as a science, but never has it risen to such a height of perfection as in our own day, when, not content with culling the most brilliant flowers of literature, its promoters have sought the aid of high class pictorial embellishment in heralding forth their announcements. The *Standard Life Assurance Co.'s* prospectus, printed on the finest paper, is headed with a reduced copy of one of the innumerable pictures of the Queen, representing her with a sleeping babe on one arm, whilst one of larger growth essays to climb the other. The circular panel containing this pretty domestic peep, has the royal supporters, and a scroll beneath carries the inscription, "*Prospice, aspice, respice.*" Elegant initial characters adorn the typography, and the whole production exemplifies the peculiar bent of the age in making judicious applications of what at first sight appears a string of incongruities.

Railway Casualty.—A slight mishap occurred the other day on the Caledonian Railway to the mail train which arrives in Glasgow at 1 o'clock in the afternoon. As we neared the Beatock station we were aroused by the sudden shutting-off of the steam, followed up immediately afterwards by the bringing-up of the train with an unpleasant shock. On inquiry it turned out that a heavy luggage train proceeding northwards on our line of rails, was for some reason or other behind time, and to prevent the chance of the occurrence we now relate, a man was sent back to signal to us to slacken speed. Unfortunately, the signal man had not advanced sufficiently in the rear of the luggage train, and as there were two sharp curves at the part of the line in question, the driver did not see his danger until too late entirely to prevent a collision. The engine struck the rear waggon of the luggage train with some smartness, and the framing and buffer springs of the carriage we were in—a first-class one—were broken, whilst all the rest were uninjured. To show the position of this carriage in the train, we may mention, that next to the tender was the luggage van, and then a second-class carriage, after which came ours, and two or three more first and second-class carriages brought up the rear. Thus the broken carriage was pretty nearly in the centre of the train—a position usually chosen as the safest. The occurrence caused no other inconvenience than a slight delay, and after procuring another carriage, we were duly landed at the temporary station at the head of Buchanan Street.

An Engine-Builder's Charges.—A motion for a new trial was heard in the case of Croome *v.* Fairbairn and another, in the Court of Exchequer, on the 6th November last, on the ground of misconception of evidence by the jury, and the verdict being perverse. The circumstances of the case seem to have been, that Messrs. Fairbairn, the defendants, having undertaken a government contract for building a steamer, employed Mr. Croome, an engineer at Bristol, to make slide pieces and other metal fittings required for a screw steamer. Mr. Croome sent in a bill amounting to £2,280 10s. for this work, which Messrs. Fairbairn refused to pay, alleging the charges were excessive. Mr. Croome brought an action to recover the amount against the Messrs. Fairbairn, which was heard before Lord Chief Baron Pollock, at the London Sittings after Trinity Term last. At this trial Messrs. Fairbairn adduced sufficient evidence to show that £1,200 was sufficient for the work done, as that sum had been paid to another engineer for similar fittings to a vessel of the same description. Mr. Croome, however, made a claim for the expenses attendant on the erection of furnaces, and the manufacture of tools and implements required for the work. A verdict was then obtained by the plaintiff, Mr. Croome, for £450, besides £1,000 which had been paid into court, and, in consequence, this application for a new trial was made. The court granted the rule for a new trial upon the ground, that if a charge for implements could be made, so could a claim for a scientific education.

Clark's Self-acting Valve Trap.—Messrs. Clark, of the lead works, Reading, have introduced a clever substitute for the bell-trap, intended for the prevention of the escape of effluvia from drains. It consists of a strong leaden receiver, 4½ inches in diameter, having a brass grating on the top. The bottom of this receiver has a circular hollow ring all round, deep enough to retain half an inch of water, into which the outer edge of a hollow tinned copper ball drops. This ball is conical in shape, with a convex bottom, and the projecting edge at this part forms a valve by sinking into the annular water groove—the discharge pipe passing out from the centre of the receiver's bottom. When the liquid rushes through the brass grating into the receiver, the ball floats, and permits of its escape; and as soon as the discharge is over, its bottom annular projection, sinking into the water groove, forms a secure and close junction. The arrangement allows full water way; and the bottom of the receiver, forming the trap, being shallow, the force of the discharge carries everything clear over the pipe.

Brandt's Anti-Friction Bearings.—Mr. Coles, of Charing Cross, was the first, as far as we are aware, who put in practice anything like a system of anti-friction journal bearings, substituting the rolling action of one, two, or three detached pulley wheels for the direct rubbing action of the carriage axle. These pulleys were of large diameter, and were carried up, and quite free from, the axle-box. The action of these pulleys, as exhibited to us, no longer ago than last week, by Mr. Coles, so far answers the intended end in the model, and with the carriages on an accurate surface, as to cause an enormous diminution in the axle friction. What the result would be, in the rough routine of practice, has now remained for many years to be seen. A few years ago, Mr. Mallet of Dublin patented a scheme for a similar purpose, where for Mr. Coles' pulley arrangements he substituted a set of rollers of small diameter, confined to the axle-box, and directly surrounding the journal. This again has not come into general use, for reasons best known to the inventor. We have now before us a third attempt of Mr. W. Gaspard Brandt, of London, who has just patented an arrangement which treads closely upon that of Mr. Mallet, in so far as he applies rollers to the journal. The only perceptible difference is, that in Mr. Brandt's scheme two rollers only are set to bear on each side of the upper portion of the journal; whilst, according to the older notion, a set of six or eight were arranged at regular intervals around the journal. The patentee tells us that the adoption of his plan will insure a saving in tractive power equal to one-half; but he has forgotten to point out wherein his idea differs from those of a prior date, or, if much difference really exists, what he gains by a modification of plans which modern engineering practice has tacitly condemned.

Improvements in Locomotive Engines.—After the lapse of so many years of silence, Mr. Timothy Hackworth, George Stephenson's stoutest opponent in the celebrated Liverpool and Manchester trials of locomotives, has again come into the mechanical arena. If we are to judge from general reports, he has not, at least in later years, been an idle engineer, for he has produced a locomotive of some notability, as exemplified in the experiments on the York, Newcastle, and Berwick line. Her chief proportions are—cylinder, 15 inches diameter—stroke, 22 inches, with a single pair of driving wheels, 6 feet 6 inches diameter. She has repeatedly run at the speed of 75 miles per hour, and is expected in regular work, with a light train, to perform the 45 miles between York and Darlington in 40 minutes. The result of the experimental trials has led to the publication, by the son of the maker, the following challenge, addressed to Mr. Stephenson:—

"TO ROBERT STEPHENSON, ESQ., C.E., M.P.

"Sir,—It is now about twenty years since the competition for the premium of locomotive superiority was played off at Rainhill, on the Liverpool and Manchester Railway. Your father and mine were the principal competitors. Since that period you have generally been looked to by the public, as standing first in the construction of locomotive engines. Understanding that you have now running on the York, Newcastle, and Berwick Railway, a locomotive engine, which is said to be the best production that ever issued from Forth Street Works, I come forward, and tell you publicly, that I am prepared to contest with you, and prove to whom the superiority in the construction and manufacture of locomotive engines now belongs. At the present crisis, when any reduction in the expense of working the locomotive engine may justly be hailed as a boon to railway companies, this experiment will, no doubt, be regarded by them with deep interest, as tending to their mutual advantage. I fully believe that the York, Newcastle, and Berwick Railway Company will willingly afford every facility towards the carrying out of this experiment. Relying upon your honour as a gentleman, I hold this open for a fortnight after the date of publication.—I am, Sir, &c., "John W. Hackworth.

"Soho Works, Shildon, near Darlington, Oct. 25."

For several reasons, we do not expect that this challenge will be accepted; but if it is, it may serve as a fair exposition of the present state of locomotive mechanism, of which onlookers will reap the benefit.

British Collieries.—Northumberland and Durham have long been famed for the magnitude and number of their pits, and the capital embarked in them is estimated at no less than £10,000,000 sterling. The number of collieries in them is 140. Upwards of 700,000 tons of coal are annually converted into coke in them, supplying the greater portion of both this country and the continent. From 60 to 80 hours' burning produces, from coal of a proper quality, 56 to 68 per cent. of coke. The first coke made at the Marley Hill Works, belonging to N. Wood & Co., was in 1845. There are now 424 ovens at those and the adjoining works, and 200 more are to be added. The same company has 200 other ovens in different parts of the country, and also in various seaports in France. The Marley Hill Colliery yields 900 tons of coal per day, or 280,800 per year; which gives above 180,000 tons of coke. A report of Mr. Braithwaite Poole states the coal mines in this kingdom to be about 3,000, employing 250,000 men, women, and boys. The capital invested, he estimates at £30,000,000; and the quantity of coal obtained, 34,000,000 tons annually; the value of which, at the mouth of the pits, is £10,000,000. The quantity of coal exported from Liverpool, in 1847, was 121,587 tons; in 1848, 131,947 tons; and the entire quantity brought to Liverpool, in 1848, was 1,350,000 tons. In Scotland, there are nearly 400 coal and ironstone pits. Ayrshire has 100 pits; Lanarkshire, 150; Lothians, 61; Fifeshire, 53; Renfrewshire, 13; Perthshire, 15; Dumfriesshire, 5. In a serial now publishing, edited by Mr. Montgomery Martin, and therefore a presumably good authority, he states the amount of coal raised annually to be 30,000,000 tons (which, the reader will observe, is within four millions of the amount given by Mr. Braithwaite Poole, above quoted); iron, 1,000,000 tons; copper, 20,000 tons; tin, 5,000 tons; lead, 50,000 tons. Of hardware and cutlery, he reckons the value manufactured annually to be £20,000,000.

The Revived Disc Engine.—The disc engine, as improved by Mr. Bishopp, appears to be gaining some favour. One erected at Patrington, in Yorkshire, for pumping, is working in a business-like manner, and doing a good amount of duty. We may probably be able soon to give particulars of actual results.

Improvements in Letter Envelopes.—We have received from Mr. W. E. Hunt, of Birmingham, a specimen envelope of a novel class, wherein considerable economy in paper is effected. In describing it, the inventor says:—"It can be opened by running a penknife along the upper edge of the reverse side, which will cause the seal to be left unbroken, and the envelope will serve as a case or folio in which to keep the letter, or note, &c. It is perfectly secure from opening, or 'a sly peep at the contents,' and not inelegant in appearance. For these reasons I consider it preferable to the common envelope; but the greatest recommendation perhaps is, the consumption of less paper in its formation. This appears to me of consequence, since it will enable them to be sold cheaper. You will readily perceive this by examining the specimen. You will see that while breadthwise it requires about the same quantity of paper as the other, in the direction of its length it takes not near so much, because the turnover ends need not meet. In large sizes the difference will be much more apparent." It is in our eyes not so neat in appearance as the ordinary four flap envelope, but it does not require near so much paper. The bottom longitudinal edge is formed by folding up a back piece of the same size as the envelope face, with this difference, that the latter has three short folding flaps upon its top and two sides, the latter being gummed down upon the back piece. Without the envelope before the reader, it will be difficult exactly to comprehend the shape; but if we consider the present four flaps of the common envelope to be in a solid plain piece, straight across the top, and with a bottom fold, and that the end junctions are formed by two short flaps, its general outline may perhaps be made out. M. Rémond's machine, as described by us last month, in reference to plate 37, is now regularly at work, the atmospheric folding action being obtained through the medium of a pair of bellows, instead of the pump shown by us. The inventor's note to us was enclosed in one of his envelopes folded, gummed, and embossed at one operation by this machine, in a most creditable manner.

Minshull's Imperial Hames.—The imperial hame is the name given to a neat and useful modification of this portion of carriage draught mechanism, by Mr. Charles Minshull, of Oxford Terrace, Turner Street, London, the inventor. In place of a single draught attachment, Mr. Minshull makes the hame treble-draughted, by forming three divisions upon the link piece which receives the trace-link, thus giving three separate and distinct points of draught or bearings. The link piece is simply held at each end, and the intermediate portion is bent in easy curves to form three distinct links, so that by moving the trace-link round the angle of any division, the proper bearing can be easily adjusted as occasion may require. Where horses are subject to galled shoulders, this contrivance will be found of eminent value, as the draught pressure can be instantly removed from one part to another in the manner we have stated, without the slightest alteration in the harness. Another advantage is gained in the extension of the draught on the collar, which equalises the pressure. It is worth adding, that the modification gives an air of finish to the hame.

The Crescent Oil Lamp.—Messrs. Warner, of Jewin Street, London, have, under this name, introduced a new lamp, as an improvement upon the old solar lamp. It is constructed to burn either pale seal, whale, or vegetable oils, and by a novel arrangement of the air passages, the carbonization of the wick, hitherto so rapid, is very greatly diminished. This advantage is gained by the non-confinement of the air beneath the cap before it is allowed to act upon the wick, and the provision of an additional current of air to play upon the cotton. An additional current is also so arranged as to play upon the wick at such a point as to cause perfect combustion. The glass holder is made of such a form as to admit of the adoption of the hanging glass-dome, adding much to the elegance of the lamp.

Improvements in Steam Boilers.—Amongst the entries of papers to be read in the mechanical section at the late Birmingham meeting, was one on "Wright's Steam Generator;" but, owing to some mismanagement, the subject never came before the section. We have since received particulars of the scheme, which we may here explain:—The principle upon which it is founded, is the circulation of a small portion of highly-heated water through tubes, in communication with the great mass in the boiler. The peculiar construction of the entire apparatus will be best understood by first considering only one portion of it, that called the "cellular plate." If we imagine two sheets of corrugated iron, measuring about 2 feet by 6 feet, with the corrugations the short way of the plates, it is evident that, on laying these together, we should have a series of short open tubes, each connected by a narrow rib of metal. If we were now to take two tubes, each 6 feet in length, of rather larger bore than the two feet tubes, and had one row of apertures made in each, corresponding with the ends of the short tubes formed by the corrugated plates, these, if they could be welded to such apertures, would form one entire plate of connected tubes, with no other external openings than the four ends of the two longitudinal 6 feet tubes. This arrangement, though it would be a matter of some difficulty and expense to accomplish in wrought-iron, is easily made in malleable cast-iron. A waggon boiler has been fitted up at the manufacturer's establishment, 143 Great Suffolk Street, London, for experimental purposes. Two of the cellular plates just described are placed within the boiler, a few inches from the bottom, and are connected by short elbow pipes passing through the ends of the boiler, with two corresponding cellular plates immediately underneath the bottom of the boiler, forming the crown of the furnace; the several connections are so arranged, that a continuous circuit is maintained throughout all the tubes, which are then filled with water, amounting to about 7 gallons in this instance. This apparatus being furnished with an expansion vessel, and two safety valves, perfect security is obtained against explosion; and the temperature of this small quantity of water is, under this arrangement, readily got up to between 400 and 500 deg. Fah. In the experimental boiler and furnace under consideration, the boiler, though only 6 feet 9 inches long, 3 feet 6 inches wide, and 2 feet 6 inches deep, containing water only 9 inches deep in the centre, with two cellular plates immersed therein, measuring 6 feet and a half by 20 inches, and, under ordinary circumstances, only equal to a 4-horse power boiler, yet, such is its rapid steam-generating property in connection with the cellular plates, that steam sufficient is obtained for a 12-horse power engine. The furnace presents a grate surface of 4 feet square. The result of numerous experiments show, that upwards of 12 pounds of water are evaporated for every pound of coal, whereas, in common practice, 5 to 6 pounds of water per pound of fuel is considered an excellent performance; and, indeed, with locomotive boilers of most approved construction, employing the best coke, 7½ lbs. of water evaporated per pound of fuel is reckoned a good average duty. There is another consideration not unworthy of notice, that the furnace, with its two overarching cellular plates, full of oblong apertures in the metal connecting the short tubes, side by side, is peculiarly favourable for effecting the most intimate mixture between the air and gases in the furnace, as well as in keeping up their temperature to that degree most favourable for their perfect combination and combustion, so absolutely requisite to prevent the evaporation of smoke; the consequence is, that a constantly bright flame may be observed playing along the boiler bottom, materially assisting the evaporation process.

Death of Dr. Cooke Taylor.—The British Association has lost, in Dr. Cooke Taylor, one of its most distinguished ornaments. He was preparing to visit Birmingham, to take his place in the ranks of the members, when he was attacked by the disease which has so long ravaged the country, and died at his residence in Dublin, on the very day of the opening of the meeting. Although only forty-eight years of age, he had attained the highest standing as an instructor of the age which he adorned; and, whether we regard him as a contributor to history, biography, or general science, we are bound, in each of these characters, to accord him the highest honour. Naturally of quick perception, he added to a vigorous mind an amount of versatility quite unequalled in any contemporary. We cannot, therefore, pass over the event of his death without at least paying the tribute of a few brief lines to his memory.

Opening of the Windsor Railway.—The extension line of the Great Western Railway to Windsor was opened on the 9th ult., having been approved of by the Commissioners on the previous Saturday. Eleven trains passed to and fro during the day, under the management of Mr. Seymour Clarke and Mr. Gooch, who appear not to have over-tasked their new undertaking, for the 21 miles, from the Paddington station, required 1½ hours to traverse. On leaving the junction point at Slough, the line passes through a cutting a quarter of a mile long, and afterwards, for nearly the entire distance, it is carried on an embankment, terminating in a viaduct, which, with a fine sweeping curve, carries it to the centre of the town. The length of this viaduct is between 5,000 and 6,000 feet, and in the centre of it is a novel species of bridge, designed by Mr. Brenel, to cross the Thames, with a span of 187 feet, in order to conform to the requirements of the Admiralty, in allowing sufficient headway for the passage of vessels under sail. The bridge is on the principle of the arch and tie, the extremities of the arch being connected by strong metal ties. Its foundation is a hard gravel; and after severe trials no apparent deflection is found to exist. The Windsor station is an elegant building, abutting on the High Street. It is 270 feet in length, and roofed with iron of 70 feet span. In addition to the new line, a diverging branch has been made in order to enable royal and express trains to run up to Windsor without any detention at the junction at Slough.

Prussian Muskets.—A peculiar class of musket, having some important advantages, has been introduced into the Prussian army. The chief peculiarity is in the mode of firing, the explosion being accomplished by passing a pin through the cartridge. The barrels are of the rifle kind; and the bullets, in place of being spherical, are globular at one end, cylindrical in the middle, and conical towards the other. In the cartridge, next the bullet, is a layer of some unknown explosive compound, the gunpowder being at the bottom, and put in at the lower end of the barrel. When the trigger is pulled, a thin piece of steel enters through a hole at the back of the barrel, piercing the cartridge and gunpowder, and proceeding onward to the explosive mass. In this way the gunpowder is ignited at the front, and every particle of it is consumed, so much economy being gained in this way as to render a charge of a single dram quite sufficient, whilst the percussion-lock usually requires double that amount. It is stated that the improvement enables the soldier to fire six or eight times without lowering his piece, the range being 800 yards.

Gotto's Self-Discharging Effluvia Trap.—In the course of the superintendence of the drainage works of Dover, by Mr. Frederic Gotto, the surveyor, the inefficient state of the existing cesspool and trap system, led this gentleman to attempt to devise some improvement for the prevention of the escape of the noxious gases, and with this view he has produced an arrangement of the highest importance a self-sealing discharge. A cast-iron receiver, of rectangular section, and slightly contracted downwards, is fitted into masonry beneath the street grating. Near the bottom edge of this pan, is a socket on each side for the reception of joint pins, carrying a shallow horizontal pan. These pins are placed out of the longitudinal centre of the pan, the shorter end being weighted to equipoise it. When the discharging matter accumulates in the receiver, its weight gradually destroys the equilibrium of the pan, which then sinks at one end, and discharges its contents. The release of the weight permits the pan to resume its former position—thus sealing up the discharging orifice at its junction with the bottom of the receiver. The contrivance offers to be very effective for the purpose we have mentioned, whilst it has the advantage of a self-cleansing power.

Ocean Penny Postage.—We received the other day, through the post, an envelope bearing upon its face an engraved design, illustrative of the strong popular feeling in favour of an ocean penny postage. In the left-hand corner at the top is a head of Mercury, in a compartment of the size of the penny stamp, and having the words "ocean postage" at the top and bottom. The corresponding portion on the opposite side of the envelope is left blank for the reception of the stamp, whilst the intervening space is filled up with sketches exemplifying railway and canal conveyance, divided by a circle containing the "hand-in-hand," surmounted by a dove bearing an olive branch. A sea view, with ships and steamers, fills up the remaining space, with the exception of that required for the address. The centre bears the words—"Britain! from thee the world expects an ocean penny postage, to make her children one fraternity." The whole is very well executed, and bears the name of Mr. Valentine, Dundee, as the designer.

Preservation of Boilers from Corrosion.—At the late annual meeting of the Royal Cornwall Polytechnic Society, Mr. J. Williams, of Helstone, brought forward a simple mode of preventing the liability of corrosion in steam boilers. A small quantity of coal tar is poured into the boiler just before getting up the steam, and, when ebullition commences, it parts with all its volatile constituents, whilst its carbonaceous matter is deposited, as a crust, upon all the boiler surface, with the most complete uniformity—adhering with great firmness to the metal, owing to the peculiar action of the force which appears to effect the condensation of fluid matter on solid surfaces. A species of graphite coating is in this way formed, acting as an effectual preventive of corrosion.

Preservation of Iron Ship Bottoms.—The preservative composition invented some time ago by Mr. Hay, the practical chemist of Portsmouth dock-yard, has recently had a severe test upon the bottom of the Fairy screw-tender. In all the previous trials of Mr. Hay's composition, very favourable evidence was given of its efficacy, and this last experiment goes to show that it is superior to any other yet introduced. About three months ago, the bottom of the Fairy was payed over with two compositions, one on each side—the port side being under the management of Mr. Hay, whilst the starboard was coated with a different substance, invented by Mr. Peacock of Southampton. Since this treatment, the vessel has had a good deal of sea-voyaging, having been to Ireland and the Clyde, with a cruise in the Solent. When placed on the graving slip a short time ago, Mr. Hay's side was found to have been most effectually preserved, whilst the starboard was completely covered with accumulations of grass, seaweed, and marine matter. It is a pity this composition is not more used; we should suppose our Clyde steamers would feel the benefit of it. In connection with this subject, we find the following in the *Hampshire Guardian*, of the 14th ult.:—"The Bloodhound has been taken into dock in order to examine her bottom. This vessel is built of iron, and six months back received a coat of Mr. Peacock's composition for preserving the iron on the starboard side, and a coating of Mr. Hay's composition on the port side. Since the time it was put on, the vessel has been lying at moorings up the harbour in a position to acquire a very foul bottom. On the water being pumped from the dock it was found that both sides were considerably foul. On the port side (Mr. Hay's) was some dead and short grass and a brown slimy matter, full of different species of marine insects; but as the water left the dock a good deal of this matter dropped off, and came clean by being washed with a scoop, when the bottom was found to be perfectly smooth and free from any oxidation, and the composition itself hard and firm as when put on. The starboard side was more foul, and the growing weeds were quite green in places, and were more difficult to get off, the same brown slimy character as on the port side, but with the addition of some considerably-sized mussels. On being washed, a considerable quantity of the composition and a good deal of iron rust came off, and discovered that a large amount of oxidation had taken place. We may therefore say, that Mr. Hay's composition has again shown a vast superiority over that of Mr. Peacock's, as was proved a short time ago when the bottom of the Fairy was examined."

Floating Railway across the Tay.—This vessel is now in the Firth of Forth, for trial, as we stated, in our description of the works, in our Nos. for June and July last. To get from the Clyde to the East Coast, she had to sail round Cape Wrath, at the extreme northern end of our island,—always a voyage of some roughness, and rather a heavy one for a large flat-bottomed craft like this. The trip occupied something like four days, including three nights' stoppage by the way. Her rate will be understood from the following statement of her starting and stopping:—She left the Gareloch at 9 o'clock in the evening, and anchored the following evening at 9, off the Isle of Skye; leaving this at 6 next morning, she brought to at Thurso at 12 at night; sailing again next morning at 6, and in the evening anchoring off Girdle Ness, near Montrose. From this place she sailed at 5 next morning, arriving at Granton at 5 in the evening, being the fifth day since leaving the Gareloch in the Clyde. The day after her arrival, she was taken across the ferry passage to Burntisland, a distance of 5 miles from Granton, sailing the distance in 23 minutes. When she left the Clyde she had 150 tons of coals, with 10 tons of iron rails on board. Her complement of men amounted to nineteen—three engineers, six firemen, and three coal-trimmers, six deck hands, and the captain. The engines worked well, with steam averaging 11 inches of mercury, but the vessel was a little heavy at the wheel, owing to the length of chain passing from the midships steering-wheel to the rudders. The weather being good during the run, there was not much opportunity for ascertaining her qualities as a sea-boat; but a short trial on the Forth will decide this.

Iron Roof at the New Waterloo Railway Station, Liverpool.—Mr. J. H. Porter, the eminent corrugated iron roof builder, has furnished us with a tracing of this immense roof just erected by him. It is in three spans, of the widths respectively, of 74 feet 10½ inches; 67 feet 3 inches, and 37 feet 9½ inches. It is supported on cast-iron columns 18 inches diameter, and 30 feet in height, set 30 feet apart. The covering is of galvanized corrugated iron—the use of which for such purposes has been so excellently managed by Mr. Porter—and light is admitted through immense plates of rough plate-glass. The valley and side gutters are also formed of galvanized boiler plate. A sketch of this roof is given in "Examples of Iron Building and Roofing," just issued by Mr. Porter. We shall recur to this work next month. The glance we have given it shows us that the lithographic drawings are beautifully executed by Messrs. Day and Son.

Roberts' Signal for Railway Trains.—In January, 1848, the patent lists were startled from their propriety by the appearance of a "title," as remarkable for its length as for its peculiarity of phraseology. Being in intimate connection with the subject before us, we present it in full to tell its own tale:—"John Craft Roberts, of Holywell, Flintshire, surgeon—'A simplified and improved mode of communicating intelligence by means of electricity and magnetism, combined, or not, with steam on railways, between the carriages on the line and the engine or tender, so that the guards and passengers may give notice to the engineer or engine-driver, for the prevention of accidents, or casualties, or the mitigation of the evils thereof, and the protection of human life and property from loss or injury; and also of communicating signals by the same agency, describing the cause or causes of alarm, and a new mode of securing the passage of electricity for the above purposes, to be substituted or not for the side chains, and of communicating intelligence between distant places on the line.'" This title, in itself as long as the gist of the specification of many a valuable invention, has resulted in nothing more than the application of a galvanic battery to the ordinary alarm whistle of a locomotive. A small valve is fitted on to the side of the vertical steam tube, or pillar, carrying the whistle; and to one end of the actuating lever of this valve is attached an armature, set so as to be directly above an electro-magnet, which is supported on a bracket of the whistle pillar. The battery is placed beneath the tender, or in any other position which convenience may point out, and the connection is made in the usual way. The signalling instrument, in the form of a dial, having a simple communicating arrangement behind it, is placed on the guard's box, between whom and the engine-driver a system of signals is pre-arranged. The patentee has recently experimented with his apparatus on an engine of the London and North Western line, at the Longsight station, where its efficiency was proved to be fully equal to its ingenuity.

Water Supply of Dumfries and Maxwelltown.—The town councils of these two places intend to bring a bill into parliament, next session, for the construction of works to obtain a water supply from Lochrutton. Mr. Gale, who has been so successful in the Gorbals and Stirling works, has been elected as engineer-in-chief, and Mr. Newall as the resident engineer.

Effect of Zinc on Iron.—In the royal decrees of Belgium, for last month, is one which, to our iron-makers, must appear significant enough. It is as follows:—The Minister of War is authorized to have cast, at the cannon foundry, at Liege, on account of the English Government, three 32-pounders, 6 English feet in length, in cast-iron, each weighing about 1,593 kils., and three 32-pounders, 9 English feet in length, in cast-iron, each weighing about 2,539 kils. We do not know whether or not any peculiarity has been observed in the ore used at this foundry; but there is, of course, some reason for the execution of this order in a foreign country. In connection with the subject, we introduce some remarks recently made to us by Mr. Nasmyth, of Patricroft. In reference to his origination of the question as to the actual effect of the presence of zinc in combination with iron, he says:—"I have not yet had the means, or rather the opportunity, of testing the affair further than the experiments at her Majesty's dock-yard, Chatham, with a view to examine whether the quality of iron worked up from galvanized or zinc-coated iron was worse or better from the presence of the zinc. The results of these experiments were so satisfactory as to increase in the tensile strength of the iron, as well as to its beautifully clear silvery fracture, that it led to the natural conclusion, that an admixture of zinc, perhaps in the puddling furnace, *might* tend to its improvement. I think it would be worth while to try this—a shilling's worth of zinc thrown into the puddling furnace, and worked up with the metal, would develop its action for good or evil. I may name one remarkable fact that bears upon the question—namely, that the pig iron which is found best suited for casting guns at a celebrated foundry, near Liege, in Belgium, is made from an ore containing a considerable quantity of zinc ore in union with it. The guns cast at this foundry are celebrated for their remarkable strength; and it was the manager who drew my attention to the presence of the zinc as a *probable* reason why the iron was so distinguished. Whether he is correct or not in his surmise, I know not; but this comes in rather remarkably, after the result I obtained at Chatham. 'Putting that and that together,' I think, warrants a trial in the puddling furnace, and perhaps in the cupola; or, what would you say to a pound or so of zinc thrown into the ladleful of metal as it is run from the cupola? as a means to try whether and how much, if any, advantage is gained by this proposed admixture or *alloy* with zinc. For, if it is to do any good, it must alloy with the metal, or, peradventure, it may, in passing off, carry away with it something that should not be in the iron." Here is an obvious hint for iron-makers.

New Metal for Manufacture into Sheets.—An improved alloy for the sheet metal manufacture has been patented by a Mr. Jackson, of Brooklyn, New York. Its composition is—copper 64 ounces, zinc 22 to 26 ounces, and India tin 1 to 4 ounces. It is stated to be of great value for most sheet metal works, where the cutting press and dies are brought into play.

Haig's Blowing Machine.—Mr. Haig of Stepney, London, has introduced a useful apparatus as an exhauster or blower, for the transmission of air, whether as part of a ventilating scheme, or for use in the arts. The blower is a modification of the ordinary fan, which is driven at a high rate by a friction-edge or ring-piece, projecting at right angles from the plane of a disc on the winch-shaft, and the inner surface of which ring-piece is in frictional contact with a small pulley on the fan-shaft. Six different-sized machines are made, varying in height from 20 to 36 inches, and capable of transmitting from 2,000 to 6,000 cubic feet of air per hour.

London and North-Western Railway Stores for 1850.—A speaking illustration of the magnitude and importance of our existing railway works is given in the "Specification of Stores" required by the London and North-Western line for the ensuing year. This document covers 24 pages of foolscap, detailing the various stations for delivery of the articles. Coal is required to the extent of 18,104 tons. In "Iron and Ironworks," 35 tons of axle-guards, 50 tons of patent shaft bar-iron, 190 tons of fire bar-iron, 42½ tons of bolts, 13 tons of nuts, 102 tons of castings, 48 tons of Lowmoor or Bowling iron, 5 tons of nails, 69 cwt. of rivets, 6,360 gross of screws, 1,343 tons of Staffordshire and 120 tons of Yorkshire iron are wanted. In "Brass and Brass-work," 352 cwt. of castings, 59 tons of locomotive tubes, and 144 gross of screws are required. To these quantities are to be added, 8,960 lbs. of copper bolts, from ½ to 1½ inch; 11,200 lbs. of sheet copper, of several thicknesses; 12,678 lbs. of copper, ½ and ¾ inch. for fire-boxes; 2,539 crucibles for moulding brass; and 110,000 leaves of gold. Under the head "Timber and Wood-work," 19,367 feet of alder planks, 115 loads of beech planks, 10,000 feet of bay-wood planks, and 91,000 feet of deals, will be swallowed up by this monster line during the next twelve months.

ENGLISH PATENTS.

Sealed from 2d October, 1849, *to 7th November*, 1849.

John Cowley, Walsall, Stafford, manufacturer, and John Hickman, Aston, Warwick, clerk,—"Improvements in the manufacture of bedsteads, chairs, tables, couches, and tubular or hollow articles."—November 2d.

George Park Macindoe, Mountblow, Scotland,—"Certain improvements in machinery or apparatus applicable to the preparation, spinning, doubling, and twisting of cotton, wool, silk, flax, and other fibrous substances."—2d.

Adam Cottom, of the firm of John Elce and Co., Manchester, machine-makers,—"Improvements in machinery to be used in preparing and spinning cotton and other fibrous substances."—(Being a communication.)—2d.

John Jordan, Liverpool, engineer,—"Certain improvements in the construction of ships and other vessels navigating on water."—2d.

Lucien Vidie, formerly of Paris, France, but now of South-street, Finsbury, French advocate,—"Certain improvements in conveyances on land and water."—2d.

Frederick Octavius Palmer, Great Sutton-street, Middlesex, gentleman,—"Certain improvements in the manufacture of candles, and also in the machinery for the manufacture of such matters."—2d.

Charles Cowper, Southampton-buildings, Chancery-lane,—"Improvements in the treatment of coal, and in separating coal and other substances from foreign matters, and in the manufacture of artificial fuel and coke, and in the distillation and treatment of tar and other products from coal; together with improvements in the machinery and apparatus employed for the said purposes."—(Being a communication.)—2d.

Michael John Haines, Lucas-street, Commercial-road East, Middlesex, leather-pipe maker,—"Improvements in the manufacture of bands for driving machinery in hose, or pipes, and buffers for railway purposes."—2d.

Hiram Tucker, Roxbury, Massachusetts, United States of America,—"A certain new or improved manufacture of mantle-piece."—2d.

William Buckwell, Artificial Granite Works, Battersea, Surrey, civil engineer, and Joseph Apsey, Blackfriars, same county, engineer,—"Improvements in steam-engines, and in propelling vessels."—2d.

William Morris, Cold Bath-square, Middlesex, civil engineer,—"Improvements in the preparing of clay, and in the manufacture of bricks, tiles, and other articles made of clay or brick-earth."—2d.

James Combe, Belfast, Ireland, engineer and machinist,—"Improvements in machinery for hackling flax and hemp, and in machinery for producing flax yarns."—2d.

Alfred Barlow, Friday-street, London, warehouseman,—"Certain improvements in weaving."—2d.

William Edward Newton. Chancery-lane, civil engineer,—"Improvements in machinery for dressing, shaping, cutting, and drilling or boring rocks or stone, part of which improvements are, with certain modifications, applicable to machinery or apparatus for driving piles."—(Being a communication.)—2d.

James Buck Wilson, St. Helen's, Lancaster, rope-maker,—"Certain improvements in wire ropes."—8th.

Charles Edwards Amos, Grove, Southwark, Surrey, engineer, and Moses Clark, St. Mary Cray, Kent, engineer,—"Improvements in the manufacture of paper, and in the apparatus and machinery used therein, part of which apparatus or machinery is applicable for regulating the pressure of fluids for various purposes."—10th.

Charles Matthew Barker, Lower Kennington-lane, Surrey, engineer,—"Improvements in sawing or cutting wood and metals."—10th.

Richard Ford Sturges, and Jonathan Harlow, Birmingham,—"Improvements in bedsteads."—10th.

Enoch Chambers, Birmingham, smith,—"Improvements in the manufacture of wheels." —10th.

Thomas Keely, Nottingham, manufacturer, and William Wilkinson, same place, framework knitter,—"Certain improvements in looped or elastic fabrics, and in articles made therefrom; also, certain machinery for producing the said improvements, which is applicable in whole or in part to the manufacture of looped fabrics generally."—10th.

Samuel Brown Oliver, Woodford, Essex, gentleman,—"Certain improvements in dyeing and dyeing materials."—(Being a communication.)—10th.

Henry Henson Henson, Hampstead, Middlesex, gentleman,—"Certain improvements in railways and in railway carriages."—10th.—To be dated 14th June, 1849. By writ, &c.

Rowland Brotherhood, Chippenham, Wilts, railway contractor,—"An apparatus or mode for covering trucks and wagons on railways, road wagons, and canal boats, so as effectually to protect goods in the course of public transit from theft or damage, and, at the same time, to allow of such trucks and wagons being loaded and unloaded with equal facility."—To be dated July 18.

The two last patents being opposed, were not sealed till the 10th of November, but bear date the days they respectively would have been dated had no opposition been entered, by order of the Lord Chancellor.

Robert Parnall, London, clothier,—"A new instrument for facilitating the stitching or sewing of woven fabrics."—13th.

James Chesterman, of the firm of Messrs. Cutts, Chesterman, and Beddington, Sheffield, machinist,—"Improvements in carpenters' braces and other tools and instruments used for drilling and boring purposes."—13th.

Charles Cowper, Southampton-buildings, Chancery-lane, Middlesex,—"Improvements in the manufacture of sugar."—(Being a communication.)—14th.

Louis Adolphe Duperrey, 112 Faubourg du Temple, Paris, France, engineer,—"Certain improvements in machinery for producing figures in relievo."—17th.

Alfred Vincent Newton, Chancery-lane, mechanical draughtsman,—"Improvements in manufacturing leather."—(Being a communication.)—17th.

Charles Ludovic Augustin Meinig, Hamburgh, now residing in London, merchant,—"Certain improved modes or methods of applying galvanism and magnetism to curative and sanatory purposes."—(Being a communication.)—17th.

Charles James Pownall, Kensington, Middlesex, Esq.,—"A certain mode or method, or certain modes or methods, of ascertaining or registering the number of persons entering in or upon passenger conveyances and passage ways, and the instrument and apparatus for effecting the same."—17th.

George Edmond Donisthorpe, Leeds, manufacturer, and James Milnes, Bradford, York, —"Improvements in apparatus used for stopping steam-engines and other first movers." —17th.

William Brindley, Nelson-terrace, Twickenham, Middlesex, papier-maché manufacturer,—"Improvements in producing ornamental designs on papier-maché, and in preserving vegetable matters."—17th.

William Buckwell, Artificial Granite Works, Battersea, Surrey, engineer,—"Improvements in manufacturing pipes and other structures artificially in moulds when using stone and other matters."—17th.

Samuel Stocker, High Holborn, Middlesex, hydraulic engineer,—"Improvements in the beer-engines, beer-measures, and tobacco-boxes used by publicans."—17th.

Thomas Worsdell, Birmingham, Warwick, manufacturer,—"Certain improvements in the manufacture of envelopes and cases, and in the tools and machinery used therein." —17th.

DESIGNS FOR ARTICLES OF UTILITY.

Registered from 18th October, 1849, *to 14th November*, 1849.

Oct. 18th,	No. 2061.	William Bridges Adams, Fanfield Works, Bow,—"Part of a railway wagon."
—	2062.	How and Dudgeon, Stepney,—"Domestic filter."
—	2063.	William and Richard Sugget, Manchester,—"Power driving motion for a warping mill."
19th,	2064.	Joseph Harrison, Blackburn,—"Heddle apparatus for looms."
—	2065.	Joseph Harrison, Blackburn,—"Heddle apparatus for looms."
20th,	2066.	John Ridgway, Cauldon-place, Staffordshire,—"Water-closet basin."
22d,	2067.	Alexander Grant and Brothers, Clement's-Court, Wood-street, Cheapside,—"Stretcher and rib-joint for umbrellas and parasols."
23d,	2068.	James Rogers, Yately, Hants,—"Ventilating brick."
24th,	2069.	Richard Adams Ford, Strand,—"Fastening of a shirt collar."
—	2070.	G. Erby, Oxford-street,—"The Oxford shirt and collar band."
—	2071.	John Harrop, Sheffield, builder,—"Inodorous commode pan."
25th,	2072.	Henry and Robert Smith, Birmingham,—"Deflective plate-glass burner."
27th,	2073.	William Cook, Regent-street,—"Hydraulic gas stove."
—	2074.	Arthur Hills, Woodside, Croydon,—"Metallic carboy basket."
Nov. 3d,	2075.	Benjamin Richards, Dudley Port Foundry, Tipton,—"Metallic moulds for casting weights, and cable chain, studs, and stays."
—	2076.	Weiss and Son, cutlers, Strand, London,—"Invalid's reclining bed couch."
6th,	2077.	William Rye, Oldham,—"A 'taking-up' roller for power-looms."
—	2078.	Thomas Tozer, Dean-street, Soho,—"The Calorifere."
8th,	2079.	William Ford, Holles-street, Cavendish-square,—"The lady's winter polka jacket."
—	2080.	William Blenkiron, Wood-street, Cheapside,—"Fastening for shirt collar."
10th,	2081.	Gabriel Davis, Boar-lane, Leeds,—"Mercurial, steam, and hydraulic pressure guage."
12th,	2082.	Edward Golding, Hurstbourne Priors, Andover-road, Hants,—"Rolling barley-chumper."
14th,	2083.	Robert William Jerrard, Oxford-street,—"Washing apparatus."

TO READERS AND CORRESPONDENTS.

Discontinuance of the Stamped Edition of the "Practical Mechanic's Journal."—The publisher begs to announce that the Stamped Edition of this Journal has been discontinued; he will, therefore, feel greatly obliged if subscribers and purchasers will order it direct from the booksellers in their respective localities. Any irregularity occurring in its obtainment will be at once rectified, on application either to Mr. Hebert, in London, or to the Patent Office, Glasgow.

Mr. R. Haddington.—We have received his sketch; but on comparing it with the description already given, we do not think the subject requires any farther illustration. We are obliged by his attentions.

J. S. S. will have an account of the bow-and-string principle next month.

J. C. R., Holywell.—We are obliged by his communication. The *Synopsis* is simply printed on plain paper. The cloth covers may be obtained from London through his bookseller.

Mr. Reed.—If we can find anything likely to suit him, we shall be glad to let him have it. Has he seen the works of Ibbetson, Child, and the "Hand-Book of Turning." The two volumes of Holtzapffel's "Turning and Mechanical Manipulation," in conjunction with the third one which is promised, will doubtless include all that can be said on the subject. To go well into it would require great time and space. If we can turn his suggestion to account, we will do so when opportunity offers. Meantime, we have to tender him our thanks for the hints.

Mr. Dempster.—For certain reasons, we cannot say anything as to the three inventions to which he refers us, until the patented one is specified. We have seen the whole of them; and, in the course of a month or two, we shall pass them in review. We shall have great pleasure in hearing from him occasionally in his new quarters.

AMERICAN ENGINEERING.

LOCOMOTIVES.

It is only by collecting and comparing what has been done in various countries, that perfection, or anything approaching thereto, is at all attainable in any profession. Different circumstances and localities develop each one its own peculiarities; and to these primary causes is to be added, the effect of the application of numerous and varied mental powers in concentration upon one subject. We make these remarks as an introduction for the present article on American locomotives, by Mr. Passavant, formerly of Bradford, the author of the two practically valuable contributions to this Journal, "On the Construction of Locomotive Engines," given at pages 76 and 99, *ante*. Since the date of the appearance of these articles, the author, now of New York, has had the opportunity of visiting and examining the working arrangements of a number of the great lines of the Eastern and Northern States of America; and it is perhaps scarcely necessary for us to urge, that observations conducted there under the eyes of an engineer of Mr. Passavant's previous experience in this country, may be turned to good account by all who are interested in the important details of construction of which he treats. The American locomotive is little known in this country, at least its details are but vaguely understood; probably Mr. Passavant, whom we shall now leave to conduct his own case, will be successful in his endeavours to add to our stock of information upon it.

In the course of the pages, which are here to be devoted to the elucidation of this important branch of American engineering, many reasons will appear for a frequent expression of a favourable opinion upon the locomotives of the country, chiefly, however, in reference to the principles upon which they are constructed. In an enumeration of the many engine-builders here, there are several to be found that turn out but rough-looking work. Often, where engines have to be rebuilt at the railroad companies' workshops, more care and better workmanship are there bestowed upon them than in the shops of the original builders; but generally they lack that beautiful glossy finish, and general elegance of design, which distinguish the English locomotives above all others. The engines from some of the larger workshops form splendid exceptions to this statement.

In thus judging, however, from outward look, we must not forget those circumstances which, on railroads here, dictate economy more severely than in England, and that the materials and, above all, labour are very dear. And, generally, rough as some of the engines may appear at first sight, it is to be remembered that they are made for hard, rough usage and heavy work, whilst certain leading and excellent principles of construction are found in all, some of which it would be well to adopt in the English workshops. In explanation of these principles, illustrations will be taken from existing engines; and although there may be among these examples some that are not peculiarly commendable—for instance, among the various constructions of frames—there will be one, showing the principle which guided the design, although the manner of carrying it out might, with advantage, have been widely different.

Two engines running on different lines, by different makers, I shall introduce with plans of their construction, and compare them with engines of similar power on English roads, as being very good specimens of perhaps—at least so far as I have seen—the best American locomotives. One of them is certainly the most steady-going engine I have ever been on, either here or in Europe. One is a goods engine, on a broad guage—6 feet—line, with inside cylinders; the other is a narrow guage engine, with outside connections. Both these, and examples of other engines, are such as I have gathered myself, and the working of which I have personally observed.

The general construction of an engine is naturally modified by the circumstances under which it is to be used. The usual English passenger-engine, with its driving-wheels underneath the centre of gravity, or nearly so, can be employed with considerable profit only on a line nearly level. In ascending gradients, though but slight and of short length, the power which the engine has to exert, and for which it must be constructed, bears a most unreasonable proportion to that necessary for the propulsion of the same train on more favourable sections. In no country has the principle of making the railroad as nearly level and straight as, without most inordinate expenditure, was possible, been carried to the same extreme as in England. The engine is of the kind which works with advantage on a level road; the road was constructed to suit the engine.

This has led to enormous sums of money being laid out on levelling hills, on forming tunnels, on deep cuttings, and high and long viaducts. Still gradients and curves cannot always be avoided. Heavy and powerful engines were built, the same principle being adhered to, with the main weight resting on one pair of drivers placed in the centre, the tractive power being obtained by one pair of wheels only. As the engines increased in weight, rails and substructure had to be increased in strength; but the proportion between the weight of engine, or dead weight, and the weight of train, or paying weight, decreased. Where the gradient does not allow of the usual average velocity—where the engine has to climb up with difficulty, and slowly, even in fair weather—how much more in wet, rain, snow, and fog—it must afterwards run at a fearful rate, for which the builders scarcely designed her, to make up for lost time, to the injury of the machinery, the carriages, and the permanent way.

On the continent of Europe, economy was more considered in the construction of railways; and gradients and curves have been employed on many lines, more severe than those in England. The same style of engine, however, is employed; but the speed, generally, is slower.

In America, economy and rapidity of construction were of still greater importance. The face of the country is, perhaps, not more unfavourable than in England; but the distances between populous towns is greater, and the roads have often to pass through large tracts of land which are but thinly peopled; therefore, whatever traffic might be created by increased facilities of communication, the same amount of traffic per mile, or per 100 miles, could not, in the first instance, be calculated on, as in England. The lines are laid along the natural undulations of the country; and, where practicable, large and expensive works are avoided. Thus we see lines passing through valleys, and following all the windings of large rivers, as the Hudson River Road, along the Hudson—the New York and Erie Road, along the Delaware and Susquehanna, and many others; going round hills rather than right through by tunnels, where this would entail more expense. The consequences are, heavy grades and sharp curves.

Such engines as were originally imported from England, adapted to the English lines—which, in the infancy of railway engineering, were made more easy than within the last seven or eight years—failed on the American lines; or better, the duty they performed, that is, the profitable paying duty, bore no just proportion to their absolute power. It was soon perceived, that to import or implicitly copy English engines would be ruinous to the pecuniary interests of the roads, except the English style of building the roads were also adopted.

The ever-active, designing, and inventive spirit of the Americans was roused to build an engine to suit their roads. Experiments were made, and gradually certain principles were developed, which are now universally adopted, and enable the engines to go over arduous heavy lines with a speed equal to that used in England, and with equally heavy trains. Some of these principles would add considerably to the durability and effective power of an English engine; but the latter, as it now is made, would be of very little use on roads in this country.

The American engine I mention in the first paper, was one built by Norris of Philadelphia, about six or seven years ago, and is of a class then much used here—small and light; a truck with four small wheels in front, one pair of 4½ feet driving-wheels in front of the firebox, and outside cylinders. The peculiar style of American roads demands as light an engine as it is possible to make with a given power. Since that time, however, the system has been very much changed; eight-wheeled engines are very general, and even many ten-wheeled are used. Of both classes I shall give illustrations.

Before leaving these general remarks, I will state, *en passant*, one particular which, in comparing the work done by an English and American engine, should be taken notice of. To determine the effect of the resistance of the atmosphere in retarding the speed or absorbing the power of an engine, many experiments have lately been made. One thing is certain, that extent of surface exposed against the current determines, at equal speeds, the amount of pressure. Here the American engines labour under a manifest disadvantage. Wood being the fuel used, they are obliged to carry a high, large, top-heavy chimney, with a cumbrous sparkcatcher, very different from the small, slight chimney of an English engine. It acts against the engine, not only by its size, but also by the great leverage the heaviest part—the top—has from the centre line of the whole machine.

THE FRAME—AN INQUIRY INTO THE PRINCIPLES OF ITS STABILITY.

I premise here, that when I use the term "frame," I allude to the framebeam, bar, or plate, on one side only; and when speaking of the two sides together, with their transvere connections, as ONE structure, I shall use the term "framing."

The first great alteration, and attempt to depart in any important point from the English construction, was made in altering one of Stephenson's engines, in 1833, I believe, by substituting for the leading axle the truck-frame, still almost universally used; that is, two axles were placed close together in one frame, separate and independent from the engine. This truck bears the front part of the engine, supporting its frame, and is moveable round a pin, under the centre of the smokebox. On passing through a curve, the wheels adjust themselves to it; and the great strain and friction of the flanges against the rails, and of the axles in their bearings, is thus relieved. If the centre driving-wheels, as generally is the case, have no flanges on their tyre, there is, in a curve, but little friction against the side of the rail, and none that can exercise an injurious effect on the machinery; besides, the danger of getting out of the track in switches, &c., is entirely avoided. With the introduction of this truck, the engine was at once enabled to pass, with perfect ease and safety, and at its highest speed, through curves on the main track, such as, in Europe, would be considered hardly safe even in sidings at stations.

The next alteration of great importance was the substitution of a straight axle for the cranked axle, placing the cylinders outside the frame, letting the axles run in inside bearings. This, with the truck, completely changed the character of the locomotive.

The same genius which thus altered, perceived the necessity for a framing more rigid than the usual one, and an entirely new construction was introduced, possessing great lateral stiffness.

Why was this necessary? On outside cylinder engines being built in England, instead of a stronger, a much weaker framing was used. There, engines with inside cylinders have always been constructed with two frames on each side; one only carries, but the second one contributes greatly to the lateral stiffness of the whole. That it is not necessary, is proved by many such engines being constructed, and successfully worked in this country, with only one frame, with inside bearings. On the cylinders being placed outside, the engines were found to oscillate much more. To resist or prevent this oscillation, the only way was to stiffen the engine laterally. This was the object of the new American frame. What was done in England to oppose this injurious tendency?

It is not, perhaps, out of place here to explain, not what the oscillation of an engine is—that is well known—but what circumstances cause and produce it; for if that had been well understood, the slight plate-frame would not have been generally introduced for this class of engine.

The framing consists of two beams; or rather, it is a structure which has not only to carry a weight in a vertical direction, but is at the same time acted upon by forces against its sides in a lateral direction. In constructing it, we must take into account, and admit into the calculation, the whole duty which it has to perform, and so proportion its strength. We must inquire into all the forces which act against it in various directions, and seek to disturb its equilibrium; the same as we should, in constructing any bridge-girder or roof-truss. To carry vertically, it must possess depth according to the amount of superincumbent weight. To oppose lateral forces it must have breadth, that is, depth in the direction of the forces, to give it stiffness or rigidity.

What are these lateral forces? The rails cannot be laid in, or made to preserve, a straight even line along their sides; therefore the wheels may not be made to fit in tight between the rails. Whatever speed, consequently, the engine may go at in a straight line, but much more so in a curve, the front wheels, and hence the whole engine, will be forced over from one side of the track to the other. Reference is made in page 117, Vol. II. of this Journal, to the lateral pressure which the rails, from this cause, have to sustain. Where a pressure is sustained, there must be power to produce it; and where a power meets with resistance, a reaction is produced. This reaction on the part of the rails is experienced by the engine, which, by it, is made to roll over on the other side of the track; thence it rebounds, and thus—lateral play being always left in the bearings, to prevent the straining of the axles in curves—the bearings, and, from them, the frame, receives a succession of small shocks. These act upon the frame-plate with a leverage equal to the distance from the point of application—the wheel-centre—to the line of the centre of gravity, or, better, the neutral axis of the frame. Small as the shocks are at first, a new shock, or application of the force, being added before the effect of the former has ceased, they gradually produce, by their great leverage, a trembling or vibration of the frame-plate; which, if it be not laterally rigid enough to oppose the force, constantly increases. If we consider,—1st, that this trembling gradually spreads throughout the whole frame; 2d, where weight hangs, on its partaking of the motion, the momentum of the force is considerably increased; 3d, where there is no stiff connection with the other side of the engine, giving great depth or support to the beam laterally, the motion is the greatest; 4th, in the English outside cylinder engine, the great weight of the cylinder and steam-chests overhangs the point of vertical support, and has only a very trifling transverse stiffening; and 5th, at the leading axle the shocks are first received, and first imparted to the frame, where the transverse connection is far less rigid than at the back part of the engine,—we shall not be surprised to hear of such engines being exposed to very great oscillation; to more wear and tear, and resistance from strains; to greater injury of the permanent way—for the less the means of resisting the oscillation, the more will be its amount, and therefore the pressure against the sides of the rails increases; and, at very high speeds, on entering or leaving a curve, even to the danger of fairly swinging off the track.

The rolling motion of the engine cannot be avoided; but the tremulous one, the primary cause of such evil consequences, may, by judicious construction, be most successfully resisted. If we suppose a solid plate fixed in between the two frames, extending from this point to the firebox, or, instead of that, the two trussed together like a bridge-truss, the motion imparted to any one point of the frame would be equally distributed throughout the whole structure, and the distance between the two would be the depth of the beam, resisting lateral pressure. Such a construction would, however, not only be very inconvenient, but it would produce a strength infinitely greater than is necessary. We will examine, therefore, whether there is not a way of attaining the requisite rigidity of frame without such trussing.

On comparison, we shall find some points of material difference in the constructions of the English and American framing.

For the sake of comparison, I shall take two engines, an English and an American one, both only lately constructed, and which may be considered very good examples of their respective classes. Both are outside cylinder engines, on narrow guage lines; one is the outside cylinder engine, by Messrs. Sharp Brothers & Co. (1848) of Manchester (several engines have before been constructed by the same firm, very similar in general design, but without the tank); and the other is the "Mohawk," outside cylinder, passenger, and freight engine, on the Albany and Schenectady Railroad, N.Y., as rebuilt at the company's workshop in Albany, according to the designs, and under the superintendence, of their able engineer, Mr. M'Queen (now of the Hudson River Railroad), and is an exceedingly powerful and steady engine. These two are tolerably well matched for comparison. No. 1—the English engine—has 15-inch cylinders, and 20-inch stroke; No. 2 has 15-inch cylinders, and 25-inch stroke. One has $5\frac{1}{2}$-feet drivers, the other 5 feet; both boilers are 3 feet 6 inches diameter, the English tubes being 10 feet $7\frac{3}{4}$ long. Those of No. 2, 11 feet 10 inches. A sketch of these two engines, as placed in comparison, is appended to this article,* to which the reader is here referred; from this another advantage of No. 2 will be noticed, viz., the centre of its boiler is 4 feet $11\frac{1}{2}$ inches; in No. 2, 5 feet 7 inches above the rails, being—making allowance for the extra size of driving-wheels —$3\frac{1}{2}$ inches in favour of the former.

In engine No. 1—the English engine—the two frame-plates carry the whole weight; and, always taking the centre of gravity as the point where a force or weight is applied, the cylinders, steam-chests, smoke-box, and chimney, overhang the point of support by upwards of 3 feet. In No. 2, the frame-plates are, in front, themselves carried by the truck-frame, the vertical strain upon them being therefore less; and this support is placed underneath, or very near, the centre of the cylinders. Overhanging weight there is none, excepting the buffer-plank, with its appendages, which are certainly heavier than in No. 1; but their leverage distance from the point of support is smaller, and they are carried by a strong stay-rod. This tendency to oscillation is, therefore, removed. We find, moreover, in No. 1, a rigid leading axle, unavoidably subject to straining in curves, and one cause of oscillation. In No. 2, we find the truck moveable round a centre pin, the wheels and axles easily adjusting themselves to the curvature—thus removing a great cause of wear and tear, and loss of power. The buffer-plank of No. 2, which acts as a transverse stay between the two frames, or a support to each against a lateral force, is placed much nearer the cylinders than in No. 1; that is, where, from the suspended weight, the momentum acquired by the vibration is greatest. We find, further, at this very spot, a very strong—both laterally and vertically—cast-iron plate fixed in between the two frames, to which the cylinders are attached, a rigid connection entirely wanting in No. 1, although this is the part where it is most needed. The manner of fixing the cylinders to this plate in No. 2 is undoubtedly firmer than the attachment in No. 1 to the frames; in the former case, the bearing surface being broad, and in the latter only one row of bolts are used. Also, the straight plate of wrought-iron passing under the boiler-barrel in No. 2, fixed to the frames, and carrying the slide-bars, is a more rigid stiffening, transversely, than the curved plate, which is at the same time a carrier to the boiler in No. 1. Were the form of the frame-beam the same with the above points of difference, we should rightly suppose No. 2 a more steady-going engine. But in the construction of these beams itself, we find a better proportioning of material, to the purpose for which it is designed, in No. 2. Each plate of No. 1, supported as it is, will bear near 100 tons, vertically, without injury, if equally distributed along its length, and in a state of rest; but when we consider its lateral rigidity, its power of resistance to a force acting against its sides, the beam is of a length equal to the distance between the fire-box—where the transverse connection is firmest—to the front buffer-plank, 13 feet 5 inches broad, 8 inches deep $= \frac{7}{8}$; and its strength to resist $= \frac{(\frac{7}{8})^2 \times 8 \times 5500}{13{\cdot}4} = 2514$ lbs.; or, considering the boiler-stay a sufficiently stiff connection, the length of beam is reduced to 8·3, and its strength increased to $\frac{(\frac{7}{8})^2 \times 8 \times 5500}{8{\cdot}3} = 4044{\cdot}1$ lbs. The American frame consists of a bar of iron, 2 inches thick × 4 inches broad. The distance from the fire-box to the cast-iron plate is 11 feet 5 inches; the strength (laterally) of this beam is $\frac{4^2 \times 2 \times 5500}{11{\cdot}416} = 6{\cdot}8$ tons; and, taking into consideration the cross-stay in the centre, the length of beam is only one-half, its rigidity double. In No. 1, a force equal to 2,000 lbs., applied at the centre of this beam, is sufficient to bend it; in No. 2, 4 tons = 8,800 lbs. is necessary.† The surplus strength of the English engine, in no way contributes to increase the lateral stiffness of the structure; in the American engine it does altogether. The boiler, from its high position, exerts a lateral pressure against the frame; this diminishes the power of every frame to resist an external force. In many English outside-cylinder engines, there is not even the transverse plate, as in the one here cited; the boiler is carried by stays attached on each side, without such a connection between them; and the builders trust that the boiler itself will form this connection. But the very position of the boiler, as soon as the vibration is imparted to it, exposes it to even greater oscillation than the lower part of the engine; instead of steadying the frame, it will increase the momentum of its motion. Engineers will agree with me, that the stability of a structure should not be made to depend on the weight it has to carry; the structure must be strong, if it cannot itself resist all the external forces, in whatever direction they act against it. If that is the case, it alone can be trusted to keep steady a superincumbent weight. Who would trust the strength of a bridge, truss, or arch, where the weight of a train passing over it was necessary to bring all the posts home to their bearings?

Which of these two frames is the most scientific, and at the same time the most practical? Of two engines of equal power, which will produce the greatest useful effect? The one that works most easy, and has least oscillation and strain. Which will have the greater durability, and, therefore, be the more economical? The one which possesses greater steadiness of motion. This engine also works most easy; and it will be the one of most stability—the one best proportioned to meet the forces, whose resistance it is opposed to. I leave it to my readers to judge between the two classes of framing.

Generally, the inside cylinder engine is far more steady; but the real cause of this superior steadiness seems not to have been rightly investigated, otherwise it would have been so easy to furnish the other class with that principle of construction which was wanting to make it steady. Comparing the two classes of English engines, we are not surprised at the greater stability of the one; but we may be surprised, that, the greater oscillation being acknowledged, a construction so bad in theory, and proved by experience so insufficient, should have been retained. Not only does the inner frame of an engine with inside connection—which, however, in many cases, is not used in America—contribute to and more than double the stiffness of the structure laterally, but the position of the cylinders, and their attachment with one another and with the frame, contribute to it, and, with the cross-plate carrying the slide bars, divide the bearing length of the beam—taking it as above to resist a lateral pressure—into three parts, and increase its rigidity ninefold.

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* And will appear in our next number.—Ed. P. M. J.

† Moreover, the force being applied at the centre of the front wheels, it is in No. 1 applied near the centre of the beam; and in the second half is repeated by the driving-wheels having flanges. In No. 2 the power is applied at the end of the beam in the truck; and the driving-wheels have no flanges.

Treating on the stability of the framing, we meet with another principle in the American construction, intimately bearing upon the same subject. It is the same principle which is recognised and acted on in accordance with, in all solid constructions, in all straight and curved girders, and in arches, namely, that all external forces acting on it, tending to destroy its equilibrium, should meet in the line of resistance of such structure, and that this line of resistance should lie within it.

The direction in which the propelling power of an engine acts, is in a line with the centre of the driving-wheel. This power is transferred through the frame to the couplings and the train. If a line through the centre of the buffers and couplings lie in a level with the line of resistance and centre of driving-wheel, then the pull and resistance being all in the same level, there will be no power lost, nor will straining in the frame be produced through the injurious leverage which the resistance has upon the power, viz., the distance from the level, where the power has to be applied, to where it is exerted, *i.e.* from the line of resistance to the centre of the wheel. BOTH SHOULD FALL WITHIN THE FRAMEBEAM. The height of the couplings always remains the same; but the size of the driving-wheel, and, therefore, the position of its centre, varies very much. In some engines with the plate-frame and large driving-wheels, the plate is so shaped that this object is attained; let us compare, for instance, the two engines of the Great Western Railway, shown in Tredgold. In the "Iron Duke," the centre of the driving-wheel very nearly coincides with the top line of the main-frame; while, in the "Pyracmon," the centre lies 9 inches below the lower edge of the frame. The line of resistance being, in both cases, in the centre of the plate, the power, in one case, is much nearer where it is required, and acts, therefore, with greater advantage than in the latter. From this reason, the horn-plates, within which the axle-box rests, are exposed to a great strain, and, when the engine pulls a very heavy train, might be liable to yield. Therefore, the very strong construction of frame was adopted in engines of the Pyracmon class, having, however, the disadvantage of unnecessary weight and waste of material. The general construction of horn-plates—whether cut out of the same sheet with the frame, or riveted on—with the stay-rods between them, to oppose this yielding, is well known.

In the examples of American locomotive frames added above, the lower bar, instead of a mere stiffening stay, is as important to the bearing power of the whole as the upper one; in fact, the frame is constructed like a trussed beam, the centre line of which coincides with the centre of the driving-wheel; the back half of the frame, having a great weight to carry, is thus made of great strength; the front half is much weaker, because its true strength, transversely, is not called into action to the same amount.

Of the three examples here given, figs. 1 and 2 are for coupled engines. Fig. 1 shows a frame remarkably strong in all directions; it belongs to an engine of the class of the Mohawk, and is designed by the same engineer; it is only partly shown, the part left out, being the same as in the Mohawk, will be seen in that drawing. Fig. 2 is the frame of an engine by the Springfield Car and Engine Co., and serves to show in what way the principles of construction, detailed above, are carried out by other makers. Fig. 3* is a frame lately constructed on an engine with only one pair of drivers. Much as it varies from the other constructions, it embodies their sound principles, combined with great firmness and rigidity. At first sight, it may appear as if this frame were not a strong or good one, because it consists of two pieces; but the real centre of support is not over the axle, but at the point of suspension of the springs, and over the wheel centre; it is not the relative strength, that is, the power to resist transverse strain, but the absolute strength, or direct cohesion of the metal, which is called into action. This frame was constructed by the Matteawau Machine Building Company.

A peculiar combination of the springs for the hind-wheels will be observed in all these examples. A compensation lever is placed between the two springs, on which rests the weight; the centre of the lever being halfway between the two axles, and to its ends the springs are attached. This arrangement balances the engine beautifully. The pumping motion, its causes and consequences, have been fully described before (at page 77), and it causes the weight resting on the driving-wheels, and consequently the tractive power, to be subject to constant variation. When, by inequalities in the surface of the road, one pair of wheels would be relieved of part of the weight—which of course would, in the English construction, be thrown on the others—then this lever comes into play, and equalizes the weight between them, so that, whatever position the wheels be in, they have always the same weight resting upon them, and can always exert the same amount of tractive power.

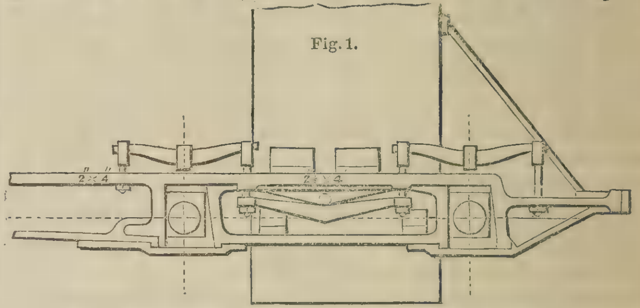

Fig. 1.

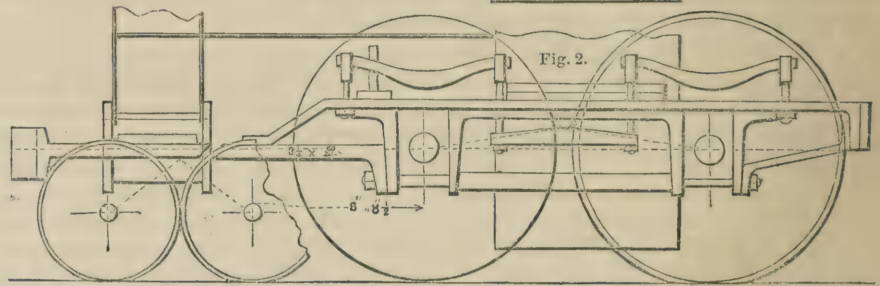

Fig. 2.

This plan is obviously to be preferred to the construction in an English coupled engine; where, on less weight resting on one pair of wheels by their descending into a hollow on the surface of the rail, a larger proportion of weight is thrown on the other pair; what one pair loses in tractive power, the other has to exert more. A similar object is attained in the 8-wheeled engines on the Great Western Road, and in that of Mr. Crampton on the fore-wheels only; where, they not being drivers, it is of less consequence in the steadying of the engine, by two wheels having only one spring. But compare the weight and expense of one spring of 6 or 7 and 8 feet long, to two common springs with the compensation lever.

This construction also adds materially to the steadiness of the engine. In English locomotives, each wheel having a separate spring, that part of the shock or jerk, which is not taken up by the spring, is imparted to the frame; by the use of the compensation lever, the two springs are affected at the same time, and to the frame is imparted only a very small part of the force, which it receives entire where no such contrivance is used. The same object, of dividing the shock upon two wheels, and thus producing a smaller effect on the body of the engine, is obtained by the use of the truck-frame. The whole engine is balanced upon two centres, in such a way that, however the wheels may stand, it is but little affected by the irregularity of their position, and, as near as it is possible, always retains an exact horizontal or level position.

In fig. 1, a stay will be noticed from the back of the fire-box to the frame, another is placed—as seen in the drawing of the Mohawk—from the smoke-box to the frame. These stays are used in most American engines, and serve to strengthen, stiffen, and, as it were, truss the whole structure. They not only steady the smoke-box, but tend to throw what little overhanging weight there is, more effectually on the wheels. Another advantage of the American frame, is the saving of expense in material and labour of construction. These are the great principles by which American engineers have successfully attempted to give steadiness, stability, and durability to their engines.

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* This figure will also be given next month.—ED. P. M. J.

I have dwelt long upon the construction of the frame, but I hope not longer than the subject deserves; the above three qualities of a locomotive, or the three virtues, are solely dependent upon a sound, well-constructed frame. A building may be ever so well and strongly built; if its foundation is bad, it will fall. The same holds good in all structures, and why not in a locomotive?

New York, November, 1849.

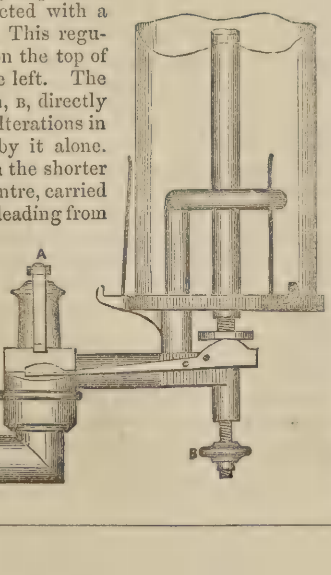
REMINISCENCES OF THE BIRMINGHAM EXPOSITION.

BIDDELL'S AUTOMATIC GAS-BURNER—DAWSON'S AUTOPHON, POLYCHORD, AND SISTICLAVE—WOOLLEY'S EQUILIBRIUM PIANO—HISTORY AND PROGRESS OF A RACK-PULLEY—KIMBERLEY'S FLOORING CRAMP—SIEMENS' EXPANSION VALVE—HEPBURN'S COMPOUND HOSE-PIPES—DOMESTIC WATER-FILTERS—COTTERILL'S DOOR-SPRINGS.

Under this collective title we have thrown together some extempore "notes and notices" of several interesting novelties, picked up during our late sojourn in Warwickshire. We have nothing wonderful to detail—no miracles of mechanism to illustrate—nay, the burden of the descriptive matter of our note-book may be considered, in the main, as of the common-place order; but experience has taught us, that the simplest remarks oftentimes find for themselves a valuable use, and that old or partially understood facts, set forth under a new aspect, do not always uselessly fill up the space allotted to them. We make these prefatory observations in order to shield ourselves from the effects of a charge of furnishing a dish of second-hand fare—a charge, by the way, not unfrequently made by knowing readers, who, in the fulness of their own information, forget that their neighbours are not perhaps equally learned.

The annexed engraving represents an elevation of a clever "practical ingenuity," recently invented and patented by Mr. G. A. Biddell of Ipswich. It is an automatic gas-burner, or at least it lays a fair claim to this title, in as far as it acts as an exact regulator to retain the flame at a constant uniform height under all variations of pressure, and in its acting as a stop-cock, which will shut off the supply of gas whenever the flame is either wilfully or accidentally extinguished. The principle of the self-acting arrangement is identical with that of Harrison's compensation or "gridiron" pendulum, where an opposing series of brass and steel bars combine to neutralize the deranging effects of thermal changes. In the present case, Mr. Biddell places a steel rod in the interior of a brass tube occupying the centre of the argand gas-flame, and the greater or less degree of heat, produced by the increase or diminution of the flame, causes the steel rod to act by expansion or contraction, upon a lever connected with a valve attached to the supply-pipe. This regulating valve is at A in the figure, on the top of the short elbow of the gas-pipe to the left. The gas is turned on or off by the button, B, directly beneath the burner, and all manual alterations in the height of the flame are made by it alone. When screwed up or down, it acts on the shorter end of a lever, C, turning on a fixed centre, carried by the horizontal portion of the tube leading from the valve, A, to the burner, and the opposite longer arm again acts upon the side-link of the regulating valve, to open or close the latter accordingly.

The brass tube is shown rising up directly through the centre of the ring of the burner, concealing the internal steel rod, which acts upon the stud above the short end of the lever, C; and thus, as before stated in reference to the office of the button, motion is given to the longer arm of the lever, for the due regulation of the gas-flow. When the gas is to be lighted, the button is turned from right to left, so as to elevate the valve about $\frac{1}{4}$ inch; and when the light is applied to the burner, a reverse turn must be given to the button until the required height of flame is secured. One of these burners was exhibited in action at the Exposition, and apparently performing its work well under trying circumstances. So long as we have no efficient universal pressure regulator, the value of this burner is obvious, At the same time, we cannot help thinking how much more efficiently a master regulator would act, without involving Mr. Biddell's excessive addition to the cost of so simple a thing as a plain gas-burner.



In the mechanism of musical instruments, we have several ingenious things by Mr. Charles Dawson of London. Amongst these are his "Autophon," or improved organ; his "Polychord," for giving to piano and organ players an increased command of octaves; and, lastly, his "Sisticlave," for attachment to pianos, so as to set them in any required key, and prevent the sounding of false notes.

The "Autophon" is to be considered as an improvement upon the class of instruments of simple mechanical action, amongst which the barrel-organ stands most prominent, and, indeed, may be taken as the type of the genus. In place of the cumbrous and expensive pin-barrels, Mr. Dawson has so arranged his melody-producing mechanism, that sheets of paper, perforated to suit the tune, answer the same end, every different sheet of paper producing a different melody. It is stated, that these sheets of paper can be furnished at as cheap a rate as ordinary music; and, as the change from one to another is made with great facility, the variety of airs and harmonies capable of being performed upon any one instrument, is multiplied in somewhat the same ratio of ease and economy as the press has conferred upon our supply of literature. The scheme also affords the power of transposition, so that, from the same sheet, the piece may be executed in any key.

The "Polychord," which we saw applied to a piano in action, is an apparatus suitable for any instrument keyed on the principle of the piano or organ. It consists of a series of short additional keys, covering the back portion of the existing keys, so as to give the appearance of a double row of keys. Each Polychord commands two octaves, so that, by the action of one finger, any given note and its octave may be simultaneously sounded without extending the hand; whilst, by the extension of the hand, so as to apply four fingers to different keys, eight notes may be sounded at once, and by one hand. This appliance may be used or not at pleasure—a sufficient length of the ordinary keys being left so accessible as to permit of execution in the usual way, whilst its presence affords the means of giving power to any particular note or passage, and of overcoming a difficulty in execution, even in the hands of a player unskilled in its use.

One, two, or three Polychords may be fitted to one instrument—for one performer, two are best, one for each hand, for the upper and lower portion of the key-board respectively. When both hands are applied to two Polychords, the effect of two performers, in respect of power and expression, is produced. This invention has received the sanction of the Society of Arts, having some time ago obtained their large silver medal.

The "Sisticlave," from the same prolific source of invention, is meant chiefly for the use of players in their pupilage, where their instructors wish to make them practise on particular keys, and to prevent their sounding incorrect notes. The mechanism adopted is very simple, being nothing more than a roller, having upon it certain projections, and placed behind and alongside the range of centre pins of the keys, so that, as the roller is turned on its axis to different points, some of the projections come in contact with certain keys, and prevent their action. When, for example, a piece in A. is to be practised, the roller is turned so as to stop off all the F. C. and G. natural keys, thus putting it out of the power of the player to sound any of those natural notes not found in the key of A.

Mr. Woolley of Nottingham is also here represented by what he terms his "Equilibrium Piano." In it, the ends of the strings are fixed upon a permanent basis, or string frame, which is set to traverse longitudinally in either direction before the action, which is, of course, stationary.

Striking off at a tangent, from music and musical mechanism, we may show that something is to be learned from a critical examination into the origin, history, and progress of a "rack-pulley" for windows. Mr. Samuel Whitfield contributes a case, showing the thirty-six different stages through which this insignificant article of domestic machinery passes in the transformation of the plain metal into the finished article. The several processes involved are—ingot-casting, rolling, stamping, pressing, piercing, dipping, burnishing, lacquering, sand-casting, turning, soldering, riveting, hardening, and tempering. In addition to this extensive series of operations—almost each one of which is a business of itself—the services of four dies, and ten pairs of press tools, are required;

and, in the various manipulations, the hands of nine men, four boys, and one woman are employed.

All these are directly engaged in the production of our simple pulley. If we were to go a little deeper, we should find that most of earth's productions assist in its formation, and yet its selling price is so small, that, if quoted, it would appear to be an absurd return for the many combined efforts of labour and science expended upon it.

As a valuable "builder's assistant," Mr. Kimberley's new flooring cramp deserves some remark. We have had so many complexities of the flooring cramp genus, that a simple and effective instrument like this has a more than ordinary claim upon our attention. It is a combination of the screw and lever, the latter being self-adjusting to its hold upon the floor joist. The fixed end of the lever is of an irregular T shape, the two projections having each a long and stout pin, or holder, projecting at right angles from their faces, so that, when the cramp is to be set for use, they stand one on each side of the attaching joist; and not being opposite to each other in the sectional plane of the joist, it follows that an excellent hold is got by the pressure of these pins on their respective sides of the joist, when a strain comes upon the contrary end of the lever. The compressing power, from this simple fixture, upon the boards to be laid, is obtained by means of a screw passing through a swivel nut in the centre of the lever, this screw being actuated by a pin in the head. It is evident, from the nature of the angular position of the holding pins, that the greater the strain arising from the screw pressure, the less risk is there of slipping. Mr. E. W. Siemens, so well known for his numerous and varied inventions, contributes a clever "variable expansion valve" for steam-engines. At the commencement of the stroke, this valve gives a full steam way, but, so soon as a sufficient quantity has accumulated for the completion of the stroke, the governor's action cuts off all further admission, and the remainder of the stroke is accomplished purely by expansion. This arrangement fulfils the three offices of the expansion valve, throttle valve, and stop valve. The application of the governor as a regulator, through the medium of expansion, is by no means novel; but, for several reasons, Mr. Siemen's modification of it is. Amongst Messrs. Hepburn's (Southwark) examples of compound leather and gutta percha bands, is a length of hose worth noticing for the ingenious idea it offers. The body of the hose is of leather, as usual; but, in place of this material being subjected to the action of the liquids, or heat passing through it, its interior surface is defended by a layer of waterproof material. The original softness and flexibility of the leather is thus maintained, as the main body of the material is kept entirely free from the injurious action of alternate wettings and dryings, which always involve extreme brittleness. Amongst the more essentially domestic articles, are to be noted Messrs. Martineau and Smith's water-filters. These are made under various modifications, some of them so simple and inexpensive that they may be introduced into the lowest class of houses. The plainest kind consists of nothing more than a small receiver for holding a sponge as the filtering medium—screwed to the front or discharge-pipe of the supply stop-cock. Thus the water is filtered as it comes from the pipe without further trouble. The same general principle is carried out in various ways;—in the most complete arrangement, the supply is received into an open-topped conical vessel, the quantity run in being regulated by a ball-cock. The bottom narrow part of the cone fits to the top of the cylindrical filtering vessel, in the base of which is a stop-cock for the withdrawal of the purified water. This apparatus is rendered self-cleansing by carrying a separate pipe from the two-way cock upon which the ball-float acts, to the base of the filtering vessel, so that, when the float-lever is elevated to turn the cock partially round, the pressure from the supply-pipe passing in below the filtering medium effectually cleanses it, carrying off all foreign matters by the upward rush of water. This is a most important point, as it reduces the cleansing operation to nothing more than the mere elevation of the lever; the two words "filter" and "cleanse" being placed to point out the motion required.

The handsome and effective door-springs of Mr. Edwin Cotterill present several notable points. The helix forming the spring power is contained in an ornamental barrel, screwed, by a plate, to the back of the door, the connecting-rod from the pressure piston being jointed to a fixed bracket on the hinge door-post. At the opposite end of the barrel is a screw, with a species of micrometer nut, for the regulation of the spring tension, which can, in this way, be adjusted to suit all kinds of doors, in point of strength, as well as to hold back the door when necessary. In the volute spring-box arrangement, the pulley of the pressing-rod, instead of running upon a flat plate on the door, acts upon a short inclined piece having a hollow at the summit, into which the pulley falls when the door is closed; the advantage being, that the door is held firm when closed, but immediately after it commences to open, the spring resistance gradually diminishes, by reason of the pulley then commencing to run down the slight incline.

MELLING'S IRON-TWISTING MACHINE.

(*Illustrated by Plate* 40.)

In our account of Mr. Thorneycroft's improvements in rails and wheel-tyres of last month, will be found a sufficient exposition of the advantages of obtaining perfect homogeneity of matter in metal surfaces, over which heavy loads are passed, either with an abrading or rolling movement; and we have now to show how, by another simple process, a vast increase in permanency may be conferred upon articles of this class, as well as upon various others, as axles, shafts, connecting-rods, and piston-rods. In these details of mechanism is frequently experienced, under a different form, the objectionable laminative tendency of rails. In shafts, for instance, where the mass is built up out of a series of bars, flaws are of frequent occurrence, through imperfect welds; and where the weld is good, a deficiency in strength and durability is generally the resulting effect of the parallelism of fibre.

To overcome this practical mechanical difficulty, Mr. Melling, of the Rainhill Iron Works, Liverpool, has proposed to twist together the bundle of constituent bars which go to form a shaft, or other forging of large size; and for this end he has devised and introduced the machine which forms the subject of our plate 40. This machine has now been in operation for a considerable period; it is not, therefore, held up simply as a novelty, but as a valuable workshop accessory.

Fig. 1 of our plate is a complete longitudinal elevation of the machine in working order, having the front heavy driving gearing removed to avoid obscuring the twisting details. In the same view are also shown the carriages on which the bars under treatment are conveyed to and from the machine.

Fig. 2 is a corresponding plan, partly in section, showing the driving gearing. In this view, a bar is represented as in the act of passing through the twisting-rollers. Fig. 3 is an end view, looking upon the delivering-rollers. Fig. 4 is a side elevation of a modification of the delivering-rollers, differing slightly from the same portion in fig. 1, in point of regulation of the upper-roller bearing. Fig. 5 is a front elevation of the first or revolving set of rollers, exhibiting the actuating mechanism whence the revolving movement round the axis of the twisting-bar is obtained. Figs. 6, 7, 8, 9, 10, and 11, represent various kinds of work as finished from the original pile of bars.

The machine stands upon a massive foundation of masonry, to the surface of which the cast-iron bed-plate is bolted. The driving power is communicated to the shaft, A, from which, motion is communicated through the pair of wheels, B B, to the transverse shaft, C C, passing right across the machine, and having a heavy fly-wheel, D, at its opposite end. From this shaft, the first pair of rollers, E E, from their peculiar movement, distinguished as the "revolving-rollers," are worked by the worm, F, which gears with the large worm-wheel, G, cast in one piece with the back of the plate, H, and bored out at the back, to work upon a fixed carrier, bolted to an upright bracket, fixed to the back part of the bed-plate. The shafts, I I, carrying these rollers, are supported in four bearings, K K, fitted into a pair of transverse cheeks, L L, bolted and keyed between the two plates, H M. The latter is supported by a corresponding plate, N, into which is fitted a turned ring, cast on the front of the plate, M; and this plate, N, is again bolted to flanges, O O, on the upright cheeks of the delivering-rollers. It is easy to see how, by this arrangement, the revolution of the main-shaft, C, communicates a revolving movement to the frame-work carrying the rollers, E E; but, in addition to this movement, they revolve also round their own axes; and this is obtained by means of the two plates, H and M, which carry round with them two small spur-pinions, P P, gearing with the fixed toothed rim, Q. This motion is then transmitted from these pinions to the rollers, through the two worms, R R, upon their shafts, to the two worm-wheels cut upon the roller shafts.

In the plan, fig. 2, the machine is shown as thrown out of gear with the driving-shaft, whilst a bar, S S, is passing through. This disengagement is effected by the two lever-handles, T T, acting each one upon a clutch-box, corresponding with similar clutches on the worms, V and V′, the latter being that through which motion is communicated to the front delivering-rollers, which latter may be thrown in or out of gear by the attendant when on the opposite side of the machine, by means of a short handle at V.

The lower of the two delivering-rollers, W W, which simply revolve round their own axes, receives its motion from the main-shaft, through the worm, gearing with the worm-wheel, X, on the second transverse shaft, Y, carrying a pinion, Z, gearing with a similar one on the lower roller-shaft. The object in giving motion to the lower roller first, being to admit of the raising and lowering of the upper one, as may be required to suit the work, the upper being driven from the lower one by the pair

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G MACHINE.

Fig. 3.

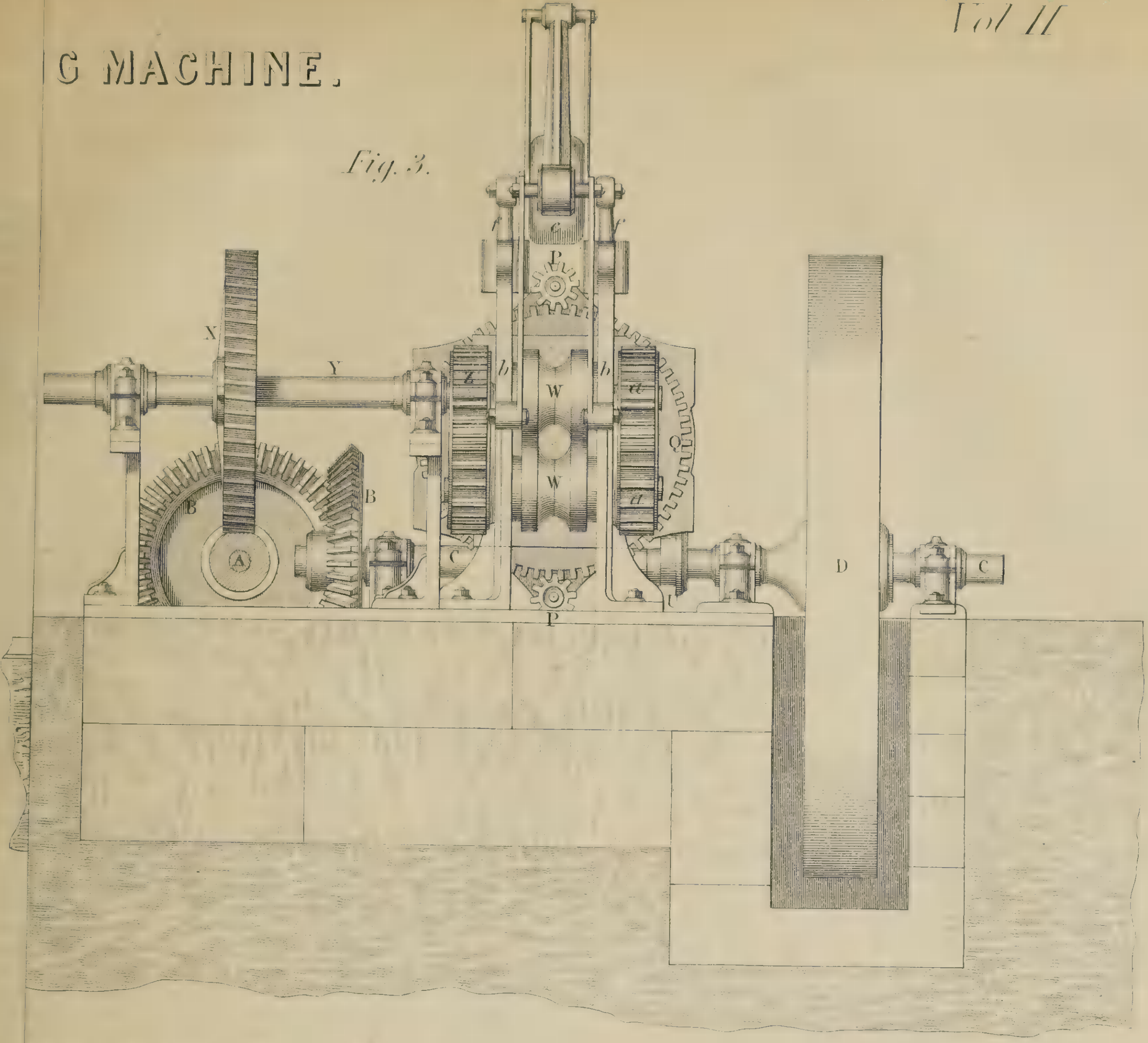


Fig. 4.

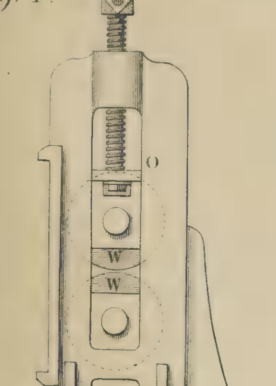
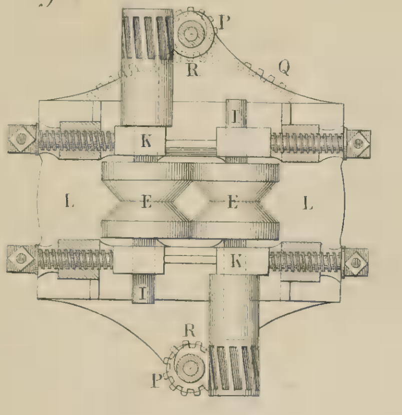
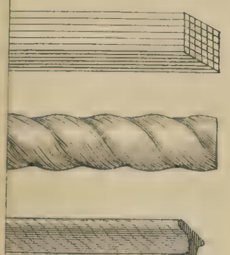


Fig. 5.





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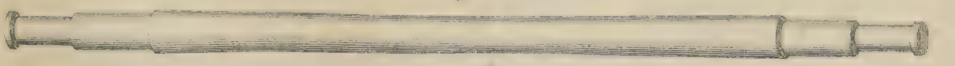

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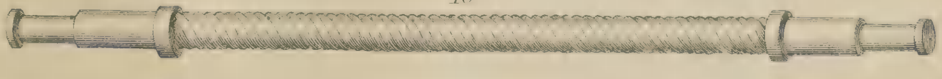

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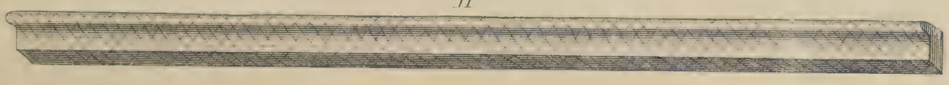


Geo. Aikman sc. Edin.ʳ

10 Feet

MELLING'S IRON TWISTING MACHINE.

Fig. 1.

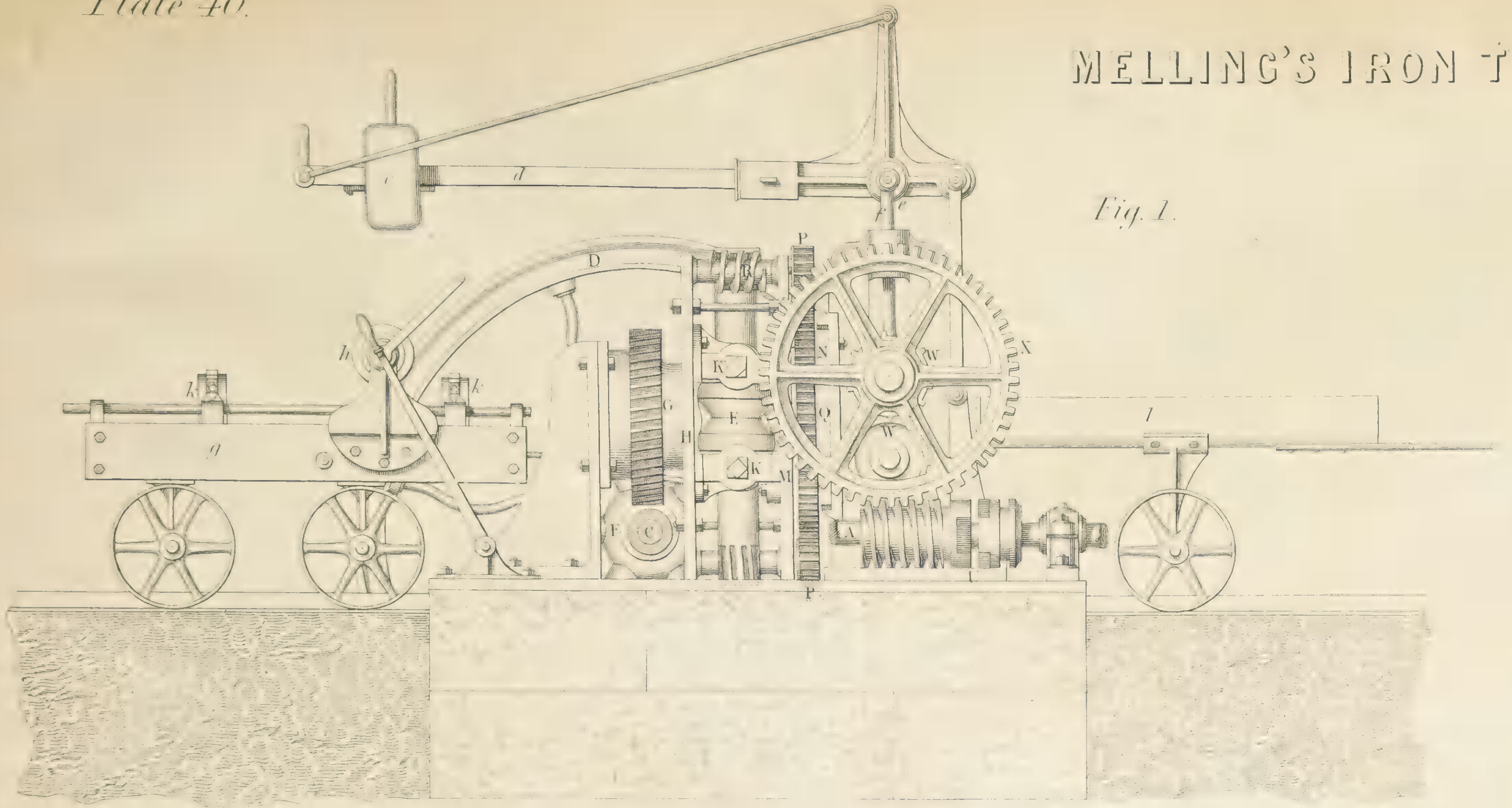


Fig. 3.

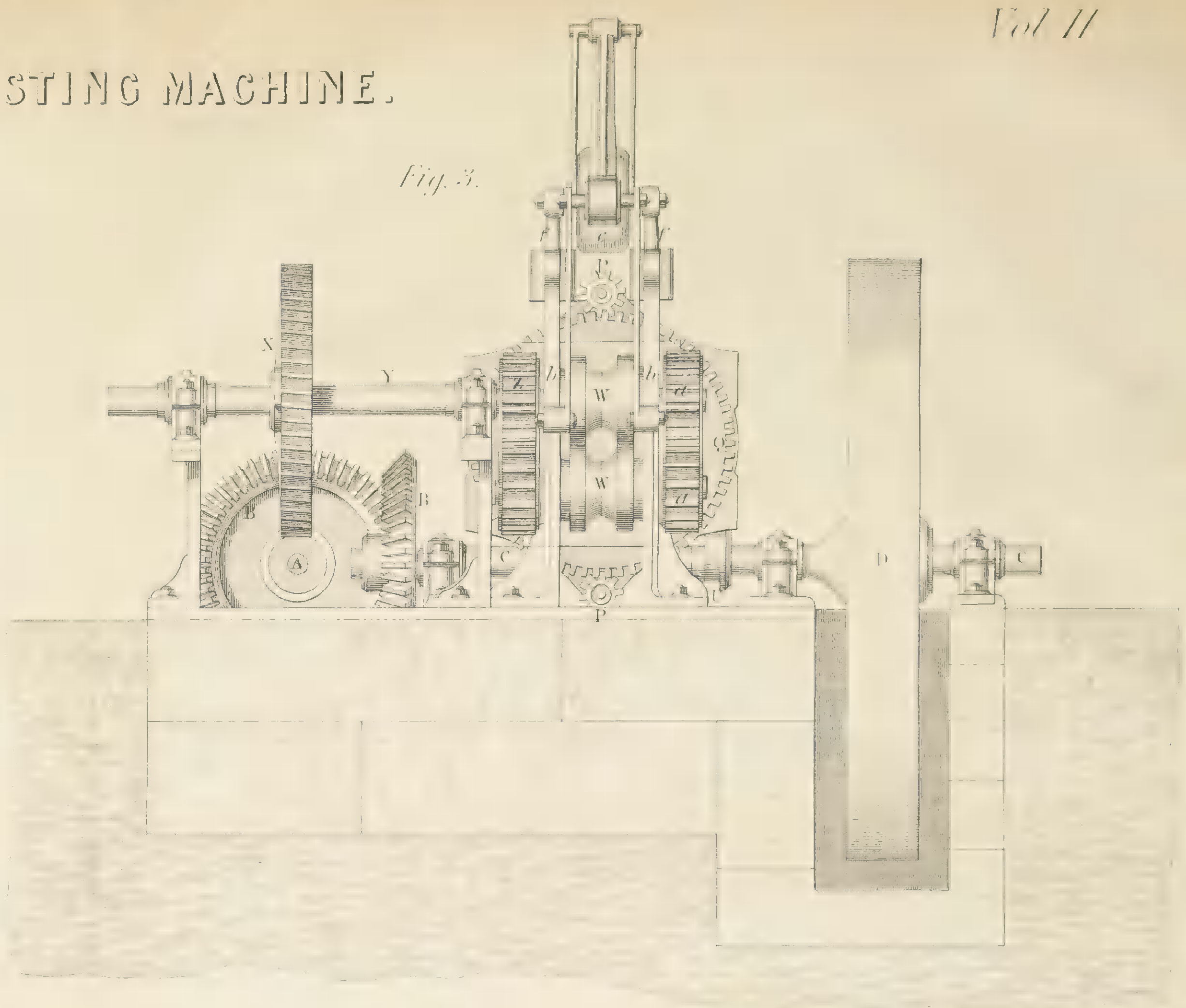


Fig. 2.

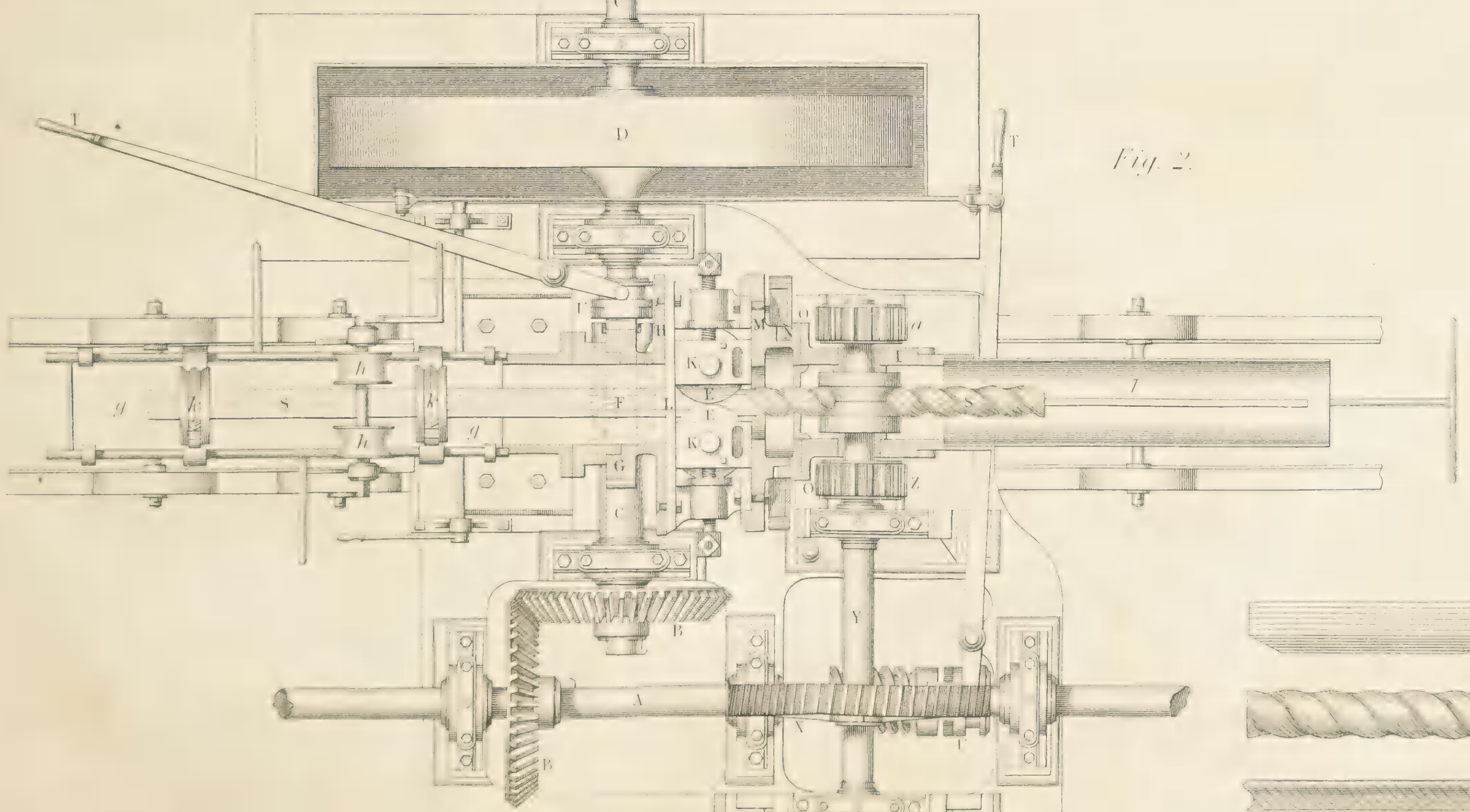


Fig. 4.

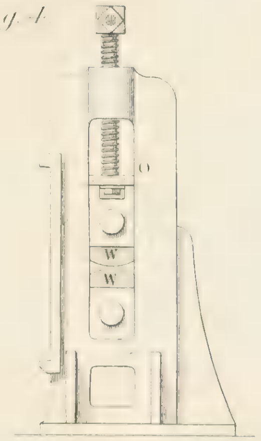
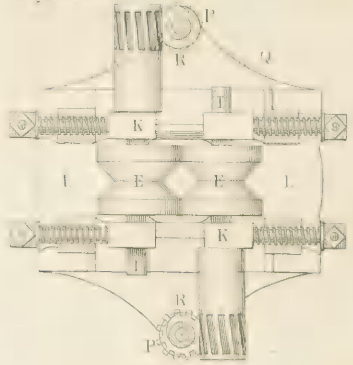


Fig. 5.



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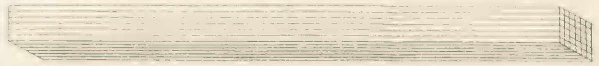

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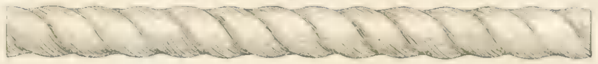

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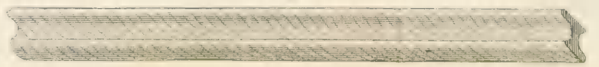

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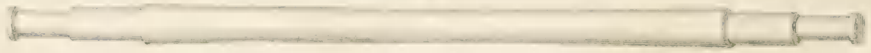

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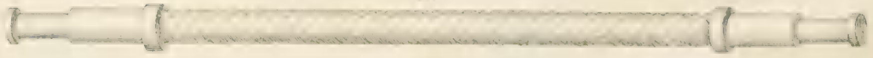

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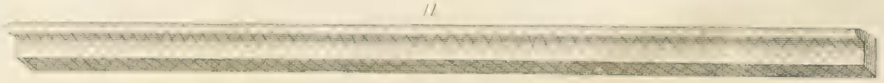

W. Johnson
Patent Office, Glasgow

Scale

1 2 3 4 5 6 7 8 9 10 Feet

of pinions, *a a*, on the opposite side of the roller standards, *b b*. In the combined views of the machine, the pressure upon the upper delivering-roller is represented as obtained from the weight, *c*, adjustable on the long lever, *d*, having its fulcrum at *e*, and pressing upon the journals of the upper roller by the two spindles, *f f*. Crane power may be applied to raise or lower this weighted lever, by attaching a chain to either of the two loops, formed for the purpose, both on the weight and on the lever. In fig. 4, the office of this weighted lever is represented as supplied by a pair of adjusting screws pressing upon the upper roller bearings.

The bars to be operated upon are brought from the furnace in the carriage, *g g*, running upon four wheels on a tram-way. The body of this carriage carries two brackets, supporting a cross-shaft, on which are two pulleys, *h h*, employed for the withdrawal of the bars from the furnace. The pulley-shaft is worked by a short winch-handle, as in fig. 1; and the ends of two chains, coiled on the pulleys, are attached to a box, which is slipped over the bar whilst in the furnace. Guides are attached to the carriage at *k k*, for the support of the bar, or pile of bars, to be twisted; and to admit of their free revolution, they are turned on the outside, and fitted into the cast-iron rings, bored to correspond. These bearing-rings are put together in halves, and are carried upon a pair of parallel longitudinal rods connected with the body of the carriage, or they may be simply suspended from a crane. The carriage for receiving the twisted bar, as delivered from the machine, is at *l* on the opposite or delivering end. It is nothing more than a semicircular iron trough, mounted upon a pair of wheels, with a drawing-handle.

These general details will afford a pretty clear notion of the construction of the machine; and a few lines more will elucidate its action in giving the requisite twist. The bar, or pile of bars, being entered between the "revolving rollers," and passed through until the end reaches the delivering pair, the upper one of this latter pair is pressed hard down upon it, so as to prevent it from turning. Being thus firmly held at this end, whilst the after portion is carried round by the revolvers, it is clear that a twist must take place; and as the simultaneous revolutions of each pair upon their own axes carry forward the bar, it is preserved perfectly straight, and an even and regular twist is given to it. It was originally supposed, and with reason, that insuperable difficulties would present themselves in the action of this machine, from the known intractability of iron when subjected to this treatment, which can only be likened to the twisting together of rope strands. Mr. Melling has, however, in the beautiful arrangements of his rollers, and the accuracy and substantiality of the machine as a whole, fully succeeded in carrying out his views.

Independent of the superior strength conferred upon wrought-iron bars formed on this compound principle, it is found of great value in all cases of sliding motion, as in piston-rods, guide-bars, and slides of all kinds. The tendency to grooving, so often experienced in piston-rods built up of parallel pieces, is a good example of what we mean, and presents a practical instance of a defect easily remediable by twisting the fibres after the fashion which we have just explained.

The several remaining figures on our plate, are illustrative details of the progress of the twisting operation, from the pile of bars to the finished articles. Fig. 6 is the original pile of rectangular bars; fig. 7 represents these bars as twisted together, previous to the subsequent finish under the hammer. In fig. 8, the twisted metal is shown under the form of a double T rail; fig. 9 is an axle finished up from the same material; fig. 10 is an axle formed out of round bars twisted together, and welded only at each end for the wheels and journals; and fig. 11 is a tyre bar, exhibiting the striated texture, as in fig. 8.

FIRST NOTIONS ON POLITICAL ECONOMY.

> "We have long desiderated that Political Economy should hold a pre-eminent place among the lectureships of a Mechanic School, where, instead of a tyrant or a disturber, it would be regarded as, and at length become, a tranquillizer of the commonwealth."—*Dr. Chalmers.*

Political Economy is that branch of social science which undertakes to investigate the facts relating to the production, the distribution, and the consumption of all those things which have value in civilized societies. It aims at ascertaining how wealth is and ought to be produced, divided, and consumed, with a view to the interest of the entire society. It is a science that advances by successive processes of analysis. As the anatomist and the physiologist pursue the nervous threads that travel through the human body as far as the microscope enables them, in the same manner the economist studies the operation of the various instruments of production, examines the results of consumption, and ascertains the healthy or morbid condition of a nation's material existence. Such subjects should be familiar, not only to those who, as legislators, are called upon to deal with economical questions, but to all those who, as employers or employed, have interests connected with the proper adjustment of those questions. It is quite possible that even accurate information and correct views may not lead us to the discovery of a social panacea; but it is certain that they are indispensable assistants in combating errors and delusions to which societies are ever liable, and which have hitherto so grievously retarded their progress.

The term Wealth must be understood to comprehend all those things which have the capacity of satisfying some one or other of our wants and desires—real or imaginary, material or mental—any of which, being in the possession of an individual, command for their possessor, by means of exchange, some of those which belong to other individuals. The idea of wealth is altogether an artificial and conventional one, for without society there would be no wealth; and although the things which constitute wealth are fundamentally, and were originally, the work and gift of nature for the benefit of all mankind, they have become, by legalized appropriation, the peculiar right of individuals. The right of property is the keystone of the social edifice. Society, for its own good, recognizes and guarantees the exclusive possession and enjoyment by individuals of certain things, and she sets up her tribunals for the purpose of authoritatively deciding disputes between *different persons* as to their right to the *same thing*. At first sight it may seem that the claim of any one person to the exclusive possession of that which was exposed to all, is not founded in abstract justice. But, irrespective of the argument, that it is now too late in point of time to discuss the question, inasmuch as an alteration in the distribution of property (supposing its present distribution to be declared unjust) would be attended with convulsions that would shake the whole of society to its basis, it can be proved that appropriated land supplies those who are excluded from its direct enjoyment with more of the means of subsistence than if it were common to all. A square league of land, sufficient to support 1200 persons, will support no more than one before cultivation has added value to the soil.*

Let us now direct our attention to the meaning of the term Value. The term has various significations, which must be carefully discriminated from that in which economists employ it. In its widest sense, it expresses the relation between human wants and those objects that can satisfy them, so that everything that is useful has value; and the air which we breathe, although not an article of sale, is valuable, inasmuch as it is everywhere and at all times wanted by man. With this view of value before them, we find certain writers distinguishing between direct and indirect usefulness; and they tell us that the former is founded on the possibility of an immediate application of commodities to the satisfaction of our wants; whilst the usefulness of commodities is indirect, when they afford us only the means of procuring that which has the property of directly satisfying our wants. They instance a man having two loaves of bread. With one he appeases his hunger; this is direct utility;—being thirsty, he exchanges the other loaf for a liquid; this is indirect utility.

But economists have really nothing to do with the word value, or any meaning of the same, except as it signifies the capacity of an object to procure by exchange some other object. The loaf of bread which a man reserves for the satisfaction of his hunger, will be valuable to him in proportion as his means of obtaining another loaf, or some other edible, are remote. If such means are not in existence, then the value of the loaf is to him greater than a thousand ingots of gold. But to import into political economy the word value, with a meaning, including an accidental and essentially peculiar degree of worth like this, would be preposterous. The value of that loaf in the eye of the economist is in no respect greater than any one of the loaves on a baker's shelf. We appraise—we *measure* any portion of wealth by that which it can procure in exchange; by its worth in other wealth and value being taken to signify the capacity of being given and received in exchange, the value of a particular commodity is ascertained by finding the several quantities of all other commodities which can be obtained in exchange for it. Hence the value, or exchange value, of a thing, is "its general power of purchasing the command which its possession gives over purchasable commodities in general." †

In all civilized societies, no individual attempts to make all the various things of which he has need. It is seen to be the most convenient plan that each member of a community should confine himself to one particular art, and that he should barter the results of his exertions in his own business for the other things he requires, and which has been made by other members of the community in their respective businesses. Hence arises the necessity of trading or exchanging those things which an individual produces, over and above what he requires for his own use, against those commodities which he equally requires, but has not himself produced. Now, direct exchange is almost always more or less difficult. A bookseller, who has nothing but books, cannot easily pay his baker, his shoemaker, and the other tradesmen with whom he deals, with the volumes on his shelves; nor can a butcher expect that the builder who has built a house, or the upholsterer who has furnished it, will settle their accounts by purchasing meat. It was therefore found expedient to devise some medium of exchange, which might easily pass from hand to hand in discharge of every kind of debt. This intermediate species of merchandise, which represents and is exchanged for all other commodities, is known as Money. All kinds of wealth have now come to be popularly estimated in money, instead of in other articles, because, as a medium of exchange, it possesses certain properties which render it more commodious than all other merchandise.

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* Charles Comte, Traité de la Proprieté.

† J. S. Miles' Principles of Political Economy.

One convenience arising from the agreement of society to adopt a given medium of exchange is, that we thus obtain a *common denominator* for the valuation of a great variety of commodities. Suppose a man to possess a house, a horse, and a piece of gold plate, we should obtain only a confused notion of their several values, if we were to appreciate them by the numerous things which can be obtained in exchange for them. But by ascertaining how much *money* each will command, we apply a common measure of value. Their separate values being compared with the same scale, we have thus a ready mode of comparing those values with each other, and of learning the amount of one individual's material wealth in comparison with the material wealth of another.

It must be remarked, however, that two things must concur to give an exchangeable value to an article:—1. It must be one which men feel a desire more or less powerful to acquire the possession of. 2. Some one or more persons, forming a part only of the community, must have the right to an exclusive enjoyment of it. It is not enough that the object should possess utility. What can be more useful than atmospheric air, seeing that without it we should cease to exist, but, being free to all, it possesses no exchangeable value. Food, on the other hand, does possess an exchangeable value; because it is not only of utility to man, but it is the property of one part of the community in exclusion of the rest. It is plain, therefore, that utility and scarcity are the two conditions of exchangeable value.

In that value with which political economy deals, we may remark the following properties:—

All value, whatever be the object whereto it is added, is of an immaterial nature. The value given to wool by being transformed into cloth, is as incorporeal as the value given to a man by the lessons of the professor. The real nature of wealth, and the phenomena of production, cannot be rightly understood if this position is not kept in mind.

All equal values, whatever be the commodities with which they are combined, are of equal worth. The value of gold and silver ore is of no higher kind than that which resides in a quantity of iron ore. Value, with whatever incorporated, is just equivalent to that which can be bought with it.

In order that a value should be real, it must be recognized, not merely by the possessor, but by other persons. If no one offers more than a thousand pounds for a particular house, it is a proof that it is not worth more than that sum, whatever may be the owner's estimate of its worth.

With the exceptions of the necessities of our nature, human wants are perpetually changing. They change with the manners and customs of nations—with the age and tastes of individuals. A moralist may term artificial flowers and pieces of jewellery useless objects; but, in the eyes of the political economist, they possess value the moment that they are found to command a price. With some persons the gratification of vanity is a want as impervious as that of hunger.

Value, then, is essentially variable. Value springs from utility, and utility from our wants, which are ever varying. At a given instant, value is a positive, fixed, and ascertained quantity; but it is so only for that instant. It is in a state of endless oscillation; and what is true at one moment of time, is not true of the next. This variableness greatly complicates many of the questions connected with the science; for the phenomena are often rendered difficult to comprehend, and the problems equally difficult to solve.

Now, since the measure of value can only be a value, and since all value is variable, it follows that there is no standard—no absolute measure of value. The absence of a fixed standard of value is the leading difficulty in political economy; because we have no means of obtaining an absolute or constant magnitude representing the value of things, but only a relative and comparative magnitude. In saying that a house is worth a thousand pounds, we say no more than that the value of the house is equal to the value of a thousand pieces of gold of an ascertained size. But the value of these pieces of gold is not a thing having an absolute existence; it is a notion only learned by means of comparing it with all the things we can get in exchange for it.

Since all wealth is variable and relative in point of value, depending upon time and place, we can only correctly compare two portions of wealth when they are in the same time and place. A hundred pounds at the present time, are worth more or less than a hundred pounds twelve months ago. A hundred pounds in London, are not the same thing as a hundred pounds at Inverness. In changing the country, climate, taxes, manners, &c., have an influence on the value of things. It is therefore totally impossible to make an exact comparison of the wealth of two nations; for though the time may be the same, the places are different. When we appraise the capitals and revenues of England and France, for example, in pounds sterling, or even in pounds weight of gold, with a view to compare the amounts, we must remember that the two sums have different degrees of value in the two countries. We shall obtain only an approximation to the truth; and so in comparing the wealth of different epochs. The conclusions of economists may be summed up in these propositions:—

That there is no certain and immutable measure of value.

That money affords no certain measure or standard of value.

Neither does grain or human labour afford any certain measure of value.

In most cases, and with due limitations as to time and space, money offers the best practical measure of value. But its fluctuating nature must never be forgotten. Grain and labour are equally liable to fluctuation in value; and, in addition, they are without some of the qualities which render the precious metals useful in arriving at an approximate solution of the question of value.

Admitting, then, that neither money nor any other commodity can serve for a fixed standard of value; yet the properties of divisibility, portability, and durability, possessed by the precious metals, together with the facts that their supply is more uniform, and their quantity less subject to variation, than that of any other commodities, cause them to be oftenest employed in the business of life to express the value of things forming the subject of exchange. The value of a commodity expressed in money is termed its price, which may be further defined as the quantity of coin for which we can buy or sell a product. "In the language of trade, a commodity is said to be more or less valuable in proportion as it will exchange for more or less money, and the money for which it is exchanged is called its price. But price and value are two different things; and the least reflection will show us, that while a commodity, at the same time and place, can have but one *price*, it may have, and it has in reality, as many values as there are other commodities in the market in which its value can be estimated."* In actual business, the price is always oscillating, to the moment when the buyer and seller strike the bargain. The one offers at first a little less, and the other demands a little more, than the sum at last agreed upon.

In reality, it is the value of a commodity in other commodities which especially concerns us; and not merely the relation which these commodities bear to money, the medium of exchange: in other words, it is the thing or things which we can obtain with the price, and not the price itself. "The *price* of a commodity is altered by changing the ratio of its quantity to the quantity of money in circulation; its *value* is altered by the augmentation or abridgment of the supply of any other commodity in the market." If money is abundant, it is cheap; and the grower of wheat receives more in exchange for his grain, and he must give more of it to procure coffee or any other commodity. If money is scarce, that is, dear—the contrary will happen.

Had not America contained numerous gold and silver mines, these two metals would be less common, but the wealth of the world would be nearly the same. If, for example, there was only half the quantity of money in circulation, the grower, in selling his grain, would only obtain half the sum he now obtains; coffee, and other commodities, would likewise only purchase half the money they now do. But the values of these different commodities would, in general, be the same, although expressed in fewer figures.

It must never be kept out of sight, that that which constitutes wealth is quite different from, is totally independent of, the merchandise (money) which serves as a means of reckoning. In other words, that which has value is wealth, not because it can procure money for its owner, but because, through the medium of money, it can procure things possessing use. It is the power of buying saleable commodities, that gives purchasing commodities their title to be called wealth, and it is this power which is usually termed value. Utility of itself is not sufficient, as we have said, to bestow value upon an object. If that object be freely at the command of the whole world, no person has an inducement to give anything in exchange for it. Value in exchange has two sources: the property of satisfying the desires or wants of men, *i.e.* utility; and the inadequacy of the commodity in point of quantity to satisfy the desires or wants of *all* the persons in whom such desires or wants are excited. It has been said that value is perpetually subject to oscillations, and it is now time to speak of the laws which govern those oscillations.

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* 'The Philosophy of Trade,' by P. J. Stirling. Edinburgh, 1846.

Economists have discovered two laws: one of which results from the relation of the *supply* of commodities by the producers of them, to the *demand* for them on the part of the rest of the community; the second depends upon the amount of the several items of expense which the producer has been at in producing his commodities; or, in other words, it depends upon the cost of production.

The price of commodities is regulated by the proportion between supply and demand. A commodity is dear in proportion to the deficiency of supply, and cheap in proportion to the plentifulness of the supply. Or, what comes to the same thing, it is dear in proportion to the greatness of the demand, and cheap in proportion to the smallness of the demand. All which is more tersely expressed in this form: The price of a commodity is in direct ratio to the demand, and in an inverse ratio to the supply. When the supply falls short of the demand, a competition begins amongst the demanders, and the price rises. On the other hand, when the supply exceeds the demand, a competition begins amongst the sellers, and the price falls. Supply must be understood to have reference not only to what actually is in the market, but also to what can be readily manufactured and taken there. There is a million pairs of stockings in the warehouse; in a few days, the manufactories can turn out another million: here is supply. We will adduce an instance or two of the alterations in supply and demand, which occasion alterations in the price of commodities. "A bad harvest, by diminishing the supply of corn, will enhance its market price, and perhaps, also, raise the market price of other descriptions of food, the supply of which is not diminished by increasing the demand for them. A new application of a particular commodity—such as iron for railways, by increasing the demand beyond what can be supplied for some time, may enhance the market price. Shoe-buckles fell greatly in market price when shoe-ribbons were first introduced; and one year, when there was a fear of cholera, and a misapprehension of the causes of it, fruit and vegetables were so little in demand as to be almost unsaleable, and the prices were accordingly much reduced.*

The cost of production is another regulator of the price of commodities. It was Ricardo's opinion that the price of commodities was best represented by the sum of all the expenses of all the several items of cost which their production has occasioned. In arriving at this conclusion, he started from these principles—that nothing is produced for the mere pleasure of producing; that all producers desire large profits; and that no one buys without the means of paying. Whence it follows, that when the price of an article does not reimburse the cost of its production, a less quantity will be manufactured, or it will cease altogether to be manufactured.

These principles are incontrovertible; and Ricardo's formula is more easily comprehended than that of supply and demand. Unfortunately, it is not sufficiently general, and does not apply to all cases. In the first place, it is not applicable to appropriated natural wealth, which has an exchangeable value, though its production has cost nothing. In the next place, it supposes an unlimited power of holding back on the part of consumers, and an unlimited power of competition on the part of producers; but neither of these positions is altogether true. Corn, for example, whatever be its price, will always be bought as a matter of necessity; and there are many commodities, the use of which custom inexorably imposes upon us. As to producers, competition, amongst manufacturers and merchants, may perhaps be unlimited; but land, the source of agricultural production, is necessarily a monopoly. Beyond certain limits, no competition is possible as to wine, minerals, &c., because vineyards and mines are fixed to certain spots of circumscribed extent, and their production is limited. These are therefore natural monopolies. There are also monopolies of another class, viz., the works of genius, pictures, literary and musical compositions, &c.

Artificial monopolies are still more numerous and varied. Patents, authors' copyrights, property in particular situations (within a fortified town, for example); when the exportation or importation of certain commodities is prohibited, or restricted with the view of protecting certain branches of industry. These are monopolies, and they have all an influence upon prices. Ricardo's formula, however, does not apply to them.

The rules just expounded are those which best explain things when left to their natural course, but they are not entirely satisfactory. Further investigations may, perhaps, discover some better formula to express the causes of fluctuation in prices.

It frequently happens that prices are influenced by accidental causes unconnected with the cost of production and the demands of consumers. But such causes are to be regarded as merely temporary, the general law coming gradually into operation again as the interference disappears. It sometimes occurs that the price of certain commodities is fixed by authority. In such cases, the consumer buys at an unfair price, the vendor receiving on every sale something beyond the natural price. When a government fixes the price, above which a purchase is prohibited (the maximum price), both the producer and the consumer are injured; the producer, because no one will work at a loss; the consumer, since he is unable to buy the commodities, either on account of their being manufactured no longer, or, if manufactured, of their being kept out of the market.

There are other accidental causes which influence supply and demand. Of these causes we may name the expectation of a good or bad harvest, the apprehension of a war, of a crisis, &c. But their operation is only temporary, and their influence is more completely appreciated in proportion to the clearness of our conceptions, as to the permanent causes regulating supply and demand.

Some economists make a distinction between the market price, or price current, and the natural or real price of commodities. The market price is the actual price for which a commodity is commonly sold; the natural price is to be taken at that sum which is exactly sufficient to defray the costs of production, together with profit calculated at its average or natural rate, and the expense of taking the commodity to market. "The natural price," says Adam Smith, "is, as it were, the central price to which the prices of all commodities are continually gravitating. Different accidents may sometimes keep them suspended a good deal above it, and sometimes force them down even somewhat below it. But whatever may be the obstacles which hinder them from settling in this centre of repose and continuance, they are constantly tending to it."

A reduction in the price of commodities is not necessarily injurious to the producer, because there may have been a reduction in the costs of producing. Such a reduction in price is a great benefit to society, especially when it affects all commodities alike, because it is then equivalent to an increase of wealth. If this be true, we are able to solve one of the most disputed questions in political economy. The question is this: If national wealth consists in the sum total of all the valuable commodities a nation possesses, how comes it that the nation should be rich in proportion as those commodities are low in price? Because our means, being composed of a given quantity of productive property, becomes the more considerable as its employment procures us more commodities; and this is the case when such commodities are cheap. This explains the general spread of easy circumstances during the last hundred years, so that simple artisans have more of the comforts of life, and are better educated than princes formerly.

CHINESE MECHANISM.—OIL-MILLS AT SHANGHAE.

On looking over my notes on the mechanical productions of the Celestial Empire, I have selected, and now present you with, an account of the works and management of some extensive oil-mills at Shanghae, which I was enabled to examine, through the kindness of Dr. Lockhart, a medical missionary, resident at Shanghae, who sent his servant to conduct myself and a brother engineer through the city to the mills. As I do not remember having seen any published account of this particular manufacture, as carried on by the subjects of "the brother of the sun and moon," my rough details may, perhaps, at least claim for themselves the charm of novelty.

The mills at Shanghae are among the largest engineering productions of the country, and the machinery, though very rough, is highly effective as far as it goes. There are two mills, close together, at the part of the city farthest from the European residences. They are exactly alike, and I saw them under the advantageous circumstance of one being at work, and the other still. The beans, from which the oil is made, are rather larger than our large marrowfat peas, of a straw colour, and very smooth and hard; the one doing duty as my initial letter is full size.

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* 'Questions and Answers on some of the Arrangements and Relations of Social Life.' Smith, Elder, & Co., London, 1848. We beg to call attention to this little work, as well as to two others by the same author—'Introduction to the Study of the Social Sciences,' and 'Outlines of Social Economy.' The publishers of these works have instructions to supply to National schools, British and Foreign schools, and to all schools supported by voluntary contributions, a limited number of copies at a nominal price. They are from the pen of a gentleman residing in London, who has expended no inconsiderable sum of money, and gratuitously devoted much of his time in communicating to boys and girls in classes an acquaintance with Social Science, which he defines as "the knowledge of the effects produced upon human well-being by human acts as causes," a large portion of which knowledge falls under the head of Political Economy. The idea of the school for the secular education of boys, which has been recently opened in Edinburgh, originated with the same gentleman. With the assistance of Messrs. George Combe and James Simpson as promoters, the school, up to the present time, has proceeded most favourably.

They are taken first to a pair of stones, rolling on edge similarly to our cement-mills, fig. 2. The stones are about 5 feet diameter, and 18 inches thick. Each is bushed with wood in the centre, and the wooden axle is passed through this, and through two or three large, square, wooden washers on each side of the stone, which are adjusted by means of a cutter passing through the axis. This last is secured to a heavy wooden frame, surrounding an upright pillar, round which the stones revolve, and which is shored in different directions to the roof. The motive power is obtained from a buffalo, of the kind called the water-buffalo, who—or which—walks round in a circle of 14 feet diameter, the diameter of the platform on which the stones roll being about 10 or 11 feet. A hopper containing the beans is placed on the revolving frame, and one of the stones is furnished with a number of projecting wooden pins, which strike a lever in their rotation, so as to shake down a determinate quantity of beans upon the platform, by raising at each stroke a tapered rod, placed in the aperture of the hopper, and which, when down, fills up the aperture, forming a sort of rough valve. I do not remember the exact arrangement of the lever; but it may be imagined, as its office is very simple. The beans do not lie deeper on the platform than the thickness of one, and the buffalo has enough to do to crush those that are there. The effect of these stones is to break and flatten the beans, but the parts of each individual bean are not entirely separated.

Fig. 2.

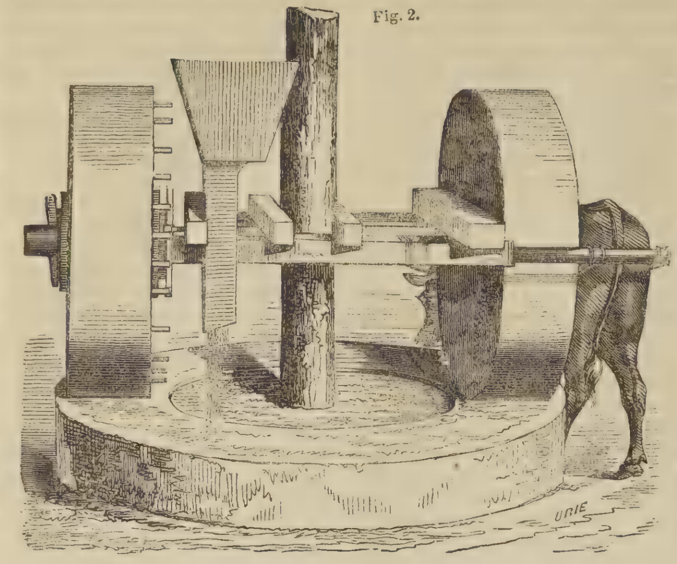
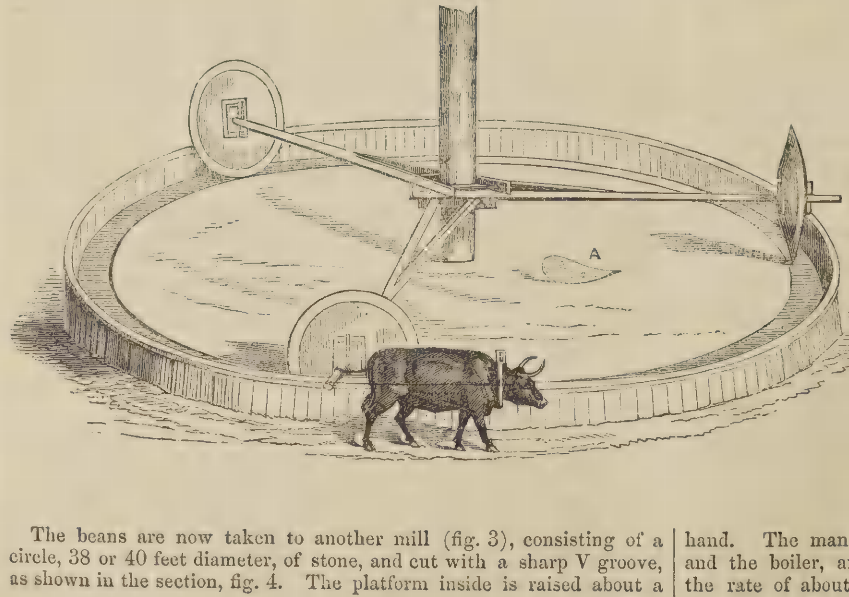


Fig. 3.



The beans are now taken to another mill (fig. 3), consisting of a circle, 38 or 40 feet diameter, of stone, and cut with a sharp V groove, as shown in the section, fig. 4. The platform inside is raised about a foot from the level of the ground outside, and is paved with stone, and has a strong wooden parapet, with a rounded coping—if the term be allowable in reference to wood—the wall itself being made of small sheet-piling. The groove in the stone is fenced with wood on each side, as in the section. The stones are 6 feet diameter, 2 feet thick at centre, and thinner towards the edge, at which they are sharpened away to an angle of about 35°. There are three such stones in the circle, and they are retained in their position by a long axis passing through the centre, which is fitted in the same manner as those of the stones previously described; and the central end of the pole is fitted with a frame which embraces an upright, fixed in the same manner as that of the first-mentioned mill. The frames of the three axes rest on each other, as shown. A buffalo is attached to each stone, and they follow each other round with the sun. I am told a Chinese buffalo will not go the other way, which is no doubt true, and highly characteristic of his nation. You will observe that the animal acts at a much better advantage here than in the small circle of the other mill, where he is literally obliged to cross his fore-legs every step to keep himself in the circle; and a powerful inducement to regularity of conduct, in this particular, is furnished to him, in the fact of his nose being attached by a ring and line to the frame of the machine, so that he cannot swerve from the *path* of duty The beans, flattened by the first mill, are brought to the second in baskets, A, fig. 3, and strewed in the groove, so as to fill it up. The stones are then set in motion, and the beans are reduced to a sort of coarse meal, about the size of the coarsest bran.

Fig. 4.

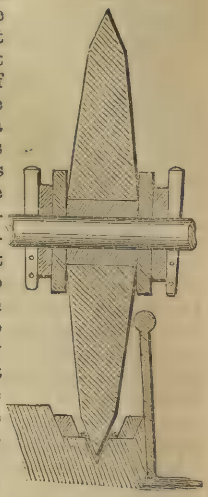
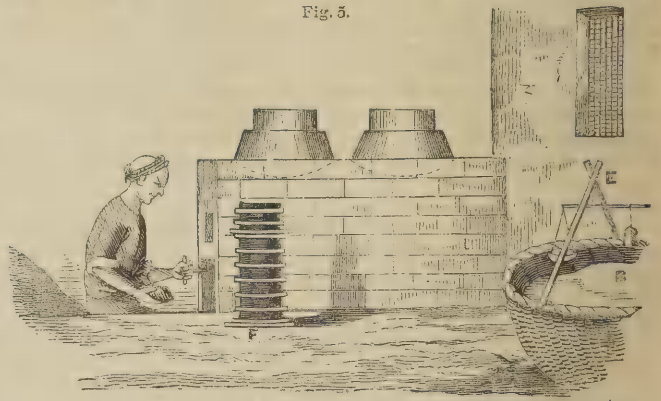


Fig. 5.



The next operation is to soften the meal by steam, and to form it into cakes, ready for pressing. This is effected by means of two boilers, consisting of the thin cast-iron spherical pans of the country, which are everywhere used in cooking. They are about 18 or 20 inches diameter, 5 or 6 feet deep, and $\frac{1}{16}$ thick. They are shown by dotted lines in fig. 5, and are set in brickwork over a furnace. On the top of the pan is a conical vessel without a bottom, of cooperage construction, and it is fitted with a sieve on the top, dropping into it a short distance for steadiness, and to make a joint. This sieve is 13 inches diameter, and is the mould for the oil-cake. The Chinaman, represented with his tail coiled round his head, according to the fashion of working men, is sitting in a large heap of chaff, with which he feeds the fire, working the bellows with his right hand, and keeping exact time with his left, which has charge of the chaff—in fact, he is a complete furnace-feeding machine. The bellows is a square-barrelled double-acting air-pump, and it is the piston-rod which he holds in his right hand. The man who makes the cakes stands between the binn, B, and the boiler, and makes one cake while another is steaming, at the rate of about $1\frac{1}{4}$ per minute. Before coming to this operation,

Fig. 6.

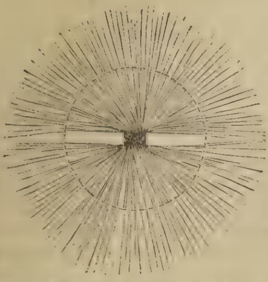
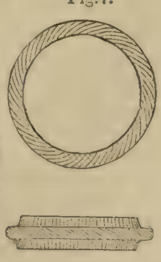
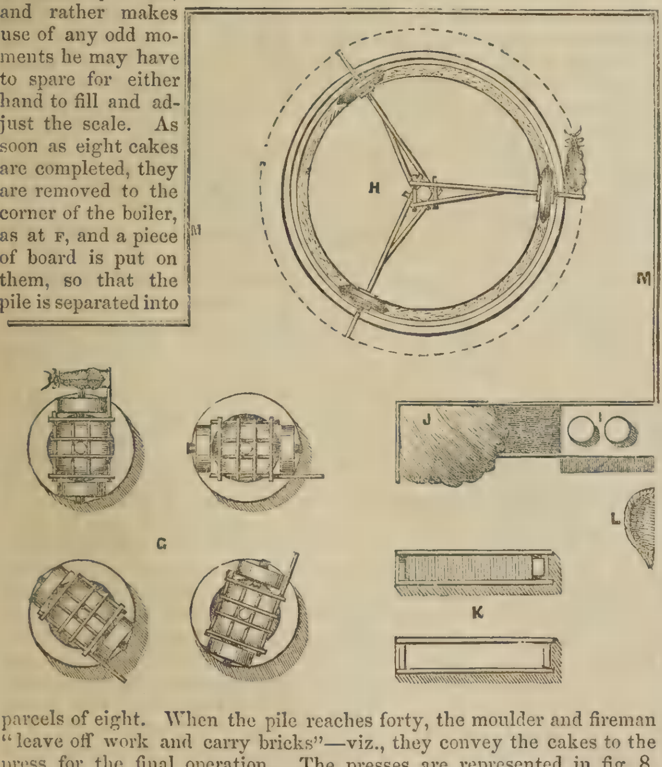


Fig. 7.



however, I must describe figs. 6 and 7. Fig. 6 represents a pair of little swabs, made of rushes, placed centre to centre, and spread out so as to form a complete circle, of about 28 inches diameter. The dotted line represents the periphery of the oil-cake. Fig. 7 is a grommet, made of ten or twelve parts of split rattan, 13 inches diameter inside, $\frac{5}{8}$ thick, the hard skin of the rattan outside, and the grommet very round and hard. The operation of making the cakes is as follows:—The man spreads the swabs down on a piece of wood, or on the last cake, in the position shown in fig. 6, takes out a sieve from the boiler, inverts and empties it upon the swabs, fills it again from the steel-yard scale, E, and replaces it upon its boiler. He then springs up with one hand on the binn, the other on the boiler setting, and gathers up the tails of the swabs with his feet, and turns them over on the cake, which they cover entirely, having first placed a small brass plate, cast with the maker's name, on the cake. He then resumes his standing position, places a grommet round the edge of the cake, which is about $1\frac{3}{8}$ inches thick, and another pair of swabs on the top, ready for the next cake. During this operation, which is performed with wonderful celerity, he contrives to weigh another scaleful of meal for the next cake; it is evident, however, that he rather piques himself upon not expending any time upon this part of the operation, and rather makes use of any odd moments he may have to spare for either hand to fill and adjust the scale. As soon as eight cakes are completed, they are removed to the corner of the boiler, as at F, and a piece of board is put on them, so that the pile is separated into parcels of eight. When the pile reaches forty, the moulder and fireman "leave off work and carry bricks"—viz., they convey the cakes to the press for the final operation. The presses are represented in fig. 8, which is a general plan of the mill, G, having four pairs of preparatory stones. H, Is the large secondary mill, which is equal to the consumption of the meal made by all the preparatory stones. I, Is the boiler; J, the heap of chaff; and at K are the presses. L, Is the binn for the meal, which is, in fact, only a very strong basket, about $4\frac{1}{2}$ feet diameter; and M is the outer wall.

Fig. 8.



The presses each consist of a rectangular frame of timber, just wide enough inside to take the cakes, with the grommets round them, and long enough to hold forty cakes in thickness, with room for a wedge. Three wedges are employed to compress the cakes, and a number of parallel wooden blocks. The wedges are driven alternately, and blocked up behind in succession, until the grommets have all come home to each other, when no more compression can take place, as the immediate bearing of the wedges is against a board filling the trough. The meal is thus squeezed into about two-thirds of its original bulk, and the oil runs out into a reservoir below. It does not appear that all the oil is obtained by this means, as the cakes have a very pleasant smell, and a taste that would not be considered to render them altogether inedible, even without the assistance of an Irish famine. The wedges are of hard wood, and are driven by a large wooden mall. The oil-cakes are sold for manure, the brass plates before-mentioned stamping the Chinese characters very legibly on their surface. I saw for sale, in Shanghae, oil-cakes measuring 2 feet 3 inches in diameter, and 3 inches thick, which must have required very powerful presses, and probably the whole of the machinery where they were made was very large. They came from Shantung province, north of the Yangtzekiang. We were told that the buffaloes are fed on a similar cake made from cotton seeds; but I do not vouch for the truth of this, as regards the particular seed of which their cakes are made. There are sixty in the mill, and they are very fat. Lest my sketch should not convey a very accurate idea of the class of animal, I may mention that they are very round and pot-bellied, hump or rather hog-backed, nose taper, head broad at top, with a neck suddenly drooping from the shoulder, colour black, dappled with mud, height 11 hands. The millstones are single blocks of granite, of a good quality; the whole of the rest of the machinery is timber, as rough as possible. The buffaloes go about two miles an hour with their load.

Engineer, R.N.

SECOND REPORT OF EXPERIMENTAL INVESTIGATIONS ON COALS FOR THE STEAM NAVY.

Details of Experimental Trials.—Second Article.[*]

Coals from Conception Bay, Chili.

This coal closely resembles the splints from the neighbourhood of Newcastle, being hard and bright, with iron pyrites, and vegetable impressions, which appear to be more recent than those found in the English coal-fields, as in many instances they resemble imperfectly charred wood. The quantity sent not being sufficient to make a complete set of experiments, it was necessary to limit the time of trial under the boiler to five hours, during which time 403 lbs. of coal were consumed, and 2,125 lbs. of water evaporated from 60° Fahrenheit. It was also found to light readily, burn freely, and give off much smoke, leaving rather large quantities of white ash and clinker, which require considerable attention on the part of the stoker in order to prevent the clogging of the bars. With care, however, a good fire, with a long flame, can be obtained, as the coal burns more like wood than any of the other varieties yet examined.

Balcarres Arley Mine.

The Arley Colliery is situated in the township of Haigh, parish of Wigan, Lancashire, and is worked at a depth of 212 yards from the surface, where the vein is 5 feet 6 inches in thickness, and very regular, with an inclination of 1 in 7 towards the south-east. This coal is described as "semi-bituminous," and is worked by walls 10 yards wide.

This mine is situated at a distance of 13 miles from Preston, which is the principal market for the coal. The current price is 6s. per ton at the pit.

In appearance, this coal differs but little from the other specimens sent for trial by the Earl of Balcarres, except that the lines of stratification are less strongly marked; it is also more free from white shale than the other varieties.

During the course of the experiments, this coal was found to light easily and burn freely, but with the evolution of much smoke during the whole time of its combustion.

The amount of ash left was rather considerable, but the quantity of clinker formed was so small, that, at the expiration of eight hours from the time of lighting the fire, the draughtways between the bars remained nearly as clear as before the commencement of the operation. The small quantity of clinker formed was very fusible, and adhered to the bars.

Carr's Hartley Coal.

The mine from which this coal was extracted is situated at Seighill, a township in the parish of Earsdon, eight miles north-east from Newcastle, and six miles from the river Tyne, where the coals are shipped by means of spouts. The colliery is worked at a depth of 100 fathoms from the surface, where a regular vein of 5 feet in thickness is found. This seam has an inclination of 1 in 36 towards the south-east.

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[*] For the earlier portion, see page 181 *ante*, for November.

The overlying and subjacent strata are composed of various beds of shale and sandstone, intermixed with the seams of coal.

This colliery is worked by the "board and pillar" system, and the produce is described "as one of the best steam-coals in the county of Northumberland, burning very freely, and requiring little stoking." It is also represented as containing little sulphur, and leaving but a small quantity of whitish ash.

In this mine 600 men and boys are constantly employed, and 670 tons of coals are, on an average, daily brought to the surface, and transported to the river Tyne by rail, from whence it is shipped for all the European ports, as well as for the East Indies and Red Sea. The current price on the Tyne is 7s. 6d. per ton. The specimen sent for trial was hard and splinty, with the lines of deposition distinctly marked, and free from iron pyrites and white shale, but contained many vegetable impressions, and a considerable amount of mineralized charcoal, which form thin beds in the lines of cleavage.

It was found, during the experiments, to light easily, burn freely, and blow off the steam rapidly, with the evolution of much smoke, and the deposit of a considerable amount of soot in the flues. Large quantities of white ash were also produced by its combustion, which makes considerable attention necessary on the part of the stoker to prevent the clogging of the grate, and the consequent stoppage of the draught. The amount of clinker found was not large, and rather resembled burnt shale than slag, as it did not fuse or adhere to the bars.

North Percy Hartley.

This coal is extracted from the main seam in the parish of Earsdon, five miles north from Tynemouth, and seven north-east of Newcastle-on-Tyne. The colliery is 220 feet in depth, and worked by the usual "board and pillar" system, as practised in the counties of Northumberland and Durham. The seam at present worked is 5 feet in thickness, and, as far as yet explored, perfectly regular. It has an inclination of 1 in 36 towards the west, and is covered by the usual sandstone and shale of the Newcastle district. This coal is shipped at Tynemouth for the different home and foreign markets, and is described "as tough in its texture and loose burning, without any tendency to choke the draught." The current price is 8s. per ton.

The specimen was a splint of a resinous lustre, with a full black colour, and appeared to contain a considerable amount of sulphur, as much iron pyrites and white shaly matter was observed in the fissures parallel to the lines of stratification. The experiments showed that this coal lights easily and burns freely, leaving a rather considerable amount of ash, and but little clinker, which is infusible, and therefore does not adhere to the bars or interfere with the draughts. Much smoke was given off during the whole time of the experiments, and whenever the fire-doors were opened, a distinct odour of sulphur was perceived. A good clear fire can, however, be maintained with this coal, and the generation of steam goes on rapidly.

Hastings Hartley Coal.

This colliery, which is worked in what is called the low main coal seam, is situated 7 miles from North Shields, and 10 miles north-east of Newcastle.

The coal is worked at a depth of 103 fathoms from the surface, where the seam is generally about 5 feet 4 inches in thickness, although it is sometimes contracted to about 3 feet. The mean dip is 2 inches in the yard towards the south-east. The seam is covered by sandstone and shale, which has the same inclination as the coal. The mine is worked by the "board and wall" system, and is about 7 miles distant from Howdon on the Tyne, where it is shipped for London, France, Denmark, the Baltic, Holland, and the Mediterranean, as also to the Black Sea.

The present current price is 7s. 6d. per ton on board at Howdon.

This coal in appearance very much resembles the foregoing, except that the lines of stratification are not so strongly marked, and that it contains less iron pyrites and white shale.

With careful stoking, this coal yields a good fire, and little smoke is evolved during its combustion. The clinker is small in quantity, and does not adhere to the bars.

Hedley's Hartley Coal.

This coal is extracted at a depth of 60 fathoms from the so-called $\frac{5}{4}$ seam, situated at Holmside, in the parish of Lanchester, in the county of Durham. The vein is regular, and has a total thickness of 4 feet 4 inches, of which 2 feet 8 inches are used as household coal, and the remaining 1 foot 8 inches for steam purposes.

The subjacent and overlying strata are composed of silicious and argillaceous rock, which, together with the seam, has a rise of half an inch in the yard. In working this seam, the lower part, consisting of steam coal, is first cut away, after which the upper portion or household coal is allowed to fall. The coals are shipped at Shields, from which port the mine is distant about sixteen miles by railway. The principal markets are London, the Mediterranean, and the Brazils.

The specimen sent to the investigation was a hard dull coal with a cubical fracture, containing apparently but little iron pyrites, but a considerable amount of the white shaly matter, of which an analysis has been given.

Under the boiler it was found to light readily, but the generation of steam goes on slowly, and a quick draught is required to produce even a tolerable fire. A few hours after the commencement of the experiments, the bars were found to have become choked by the large quantities of cinder and shaly ash, which results from the combustion of the coal, and the fire required frequent stoking and constant attention in order to keep up the steam. At the close of the experiments, large quantities of cinder and ash remained on the grate.

Experimental Fuels.

It having been repeatedly stated by eminent engineers, that the value of fuel for steam purposes depends upon the quantity of fixed carbon which it contains, it was thought that the addition of a portion of powdered anthracite, or coke-dust, to the ingredients employed in the manufacture of the various patent fuels, might materially improve their quality; and in order to test the accuracy of this opinion, as well as to ascertain the best proportions to be employed, the following experiments were undertaken at Swansea, the proprietors of Warlich's Patent Fuel Works having kindly allowed the use of their apparatus for the purpose. At this manufactory the fuel is prepared by intimately blending fine coal with gas-tar, and then pressing the mixture into the form of bricks by means of powerful machinery worked by steam-power. These blocks, when they first come from the presses, are necessarily soft and unfit for stowage, besides containing large quantities of volatile matters, which would unfavourably affect their quality as fuel.

In order to eliminate these, the blocks are placed on an iron trellis, and baked for several hours in ovens constructed for that purpose, and from whence, after cooling, they are removed in a fit state to be employed for the generation of steam.

The ingredients are usually employed in this manufactory in the following proportions: one ton of coal-dust, containing, on an average, 16 gallons of water, is intimately mixed with 16 gallons of coal-tar, and the resulting compound pressed into blocks.

In the experiments the following proportions by weight were used; viz., in the fuel marked $\frac{B}{20}$, 80 parts of dry coal, 20 of powdered anthracite, and 7·2 of coal-tar were employed, and to these were added 7 parts of water, as without it it was found impossible to obtain well-shaped blocks.

That marked $\frac{B}{40}$ was made of 60 parts of dry coal, 40 parts of powdered anthracite, 7·8 parts of coal-tar, and 7 parts of water.

That marked $\frac{C}{60}$ was manufactured from 40 parts of common coal, 60 parts of anthracite, 8·3 parts of coal-tar, and 7 parts of water.

That marked $\frac{D}{20}$ was made from 80 parts of coal, 20 parts of coke-dust, 8·3 parts of coal-tar, and 7 parts of water.

Whilst the fuel marked $\frac{E}{40}$ was manufactured from a mixture of 60 parts of coal, 40 parts of anthracite, 8·3 parts of coal-tar, and 7 parts of water.

Experimental Fuel, $\frac{A}{20}$.

Under the boiler this fuel was found to burn tolerably well when first thrown on the grate, but the fire soon gets dull, even with a quick draught, from the grate becoming choked by large quantities of ash, which speedily obstruct the draught. Some clinker was also formed during its combustion, but the amount of this was small compared with that of ash. This fuel was also observed to split into small fragments, and finally crumble into dust when the cement of coal-tar had burned away. The fire required constant attention and much stoking, in order to keep up the steam.

Experimental Fuel, $\frac{B}{40}$.

This fuel burned precisely like the preceding.

Experimental Fuel, $\frac{C}{60}$.

Although this fuel burns similarly to the preceding, it appears to yield a clearer fire when first lighted; but, as in the other cases, the grate soon grows choked with ash, and the fire becomes dull. It was also observed, that this fuel burns best when thrown on the fire in large lumps. No smoke was given off either by this or the preceding samples.

Experimental Fuel, $\frac{D}{20}$.

This fuel burns very badly, like $\frac{A}{20}$, yielding much clinker and ash, and requires frequent stoking in order to maintain combustion.

Experimental Fuel, $\frac{E}{40}$.

This fuel burns tolerably well, and but for the large quantities of ash and clinker, especially the latter, a good fire might be maintained, and the steam rapidly generated. In the early part of the experiments a clear fire was produced, the fuel appearing to burn as well as ordinary Welsh coals; but as the trial proceeded, the bars became choked, and the clearness of the fire destroyed. A little grey smoke was sometimes observed at the chimney-top.

The foregoing experiments go to show, that the addition of fixed carbon, either in the form of anthracite or coke, does not produce the advantageous results which might be anticipated; and this is probably owing to the fact of the cement and coal being first consumed, which causes the powdered anthracite and coke-dust either so to accumulate on the bars as to obstruct the draught, or to fall through the grate and escape combustion; and if it be again thrown on the fire, the air-way is choked and the action impeded. It will, however, be observed, by reference to the working tables, that the evaporative power is a little increased as the quantity of fixed carbon becomes larger; and this seems to arise from the circumstance, that when the amount of coke or anthracite occurring in the mixture is small, the greater portion of it appears to escape combustion; whilst, when a larger quantity is added, the fuel assumes in some degree the character of either the one or the other, as the case may be.

Cadoxton Fuel.

This sample was made by Warlich's Patent Fuel Company, and by them sent up for trial. In appearance it could not be distinguished from the ordinary fuels manufactured at their works, and differed from it only in being made from the Cadoxton coal, instead of that from the Graigola mine, which is usually employed for that purpose.

Under the boiler it was found to burn badly, leaving a considerable amount of ash, which obstructed the draught, and required constant attention on the part of the stoker.

Original Hartley.

The pit from which these coals were extracted is situated about 10 miles north-east of Newcastle, and 2 miles from the port of Seaton Sluice, to which place a portion of the produce of the mine is conveyed in waggons drawn by locomotives, and where vessels of 400 tons burthen may load in safety. Another portion of the coal is conveyed by rail to the Tyne, which is at a distance of 8 miles, and there loaded by means of spouts.

This colliery is one of the oldest in the district, and is that from which Northumberland coal derives its name. The daily produce of the mine is about 120 tons, the extraction of which occupies 110 men and boys; but, if necessary, four times this quantity might be raised. The present depth is 110 fathoms, where the seam is 4 feet 6 inches in thickness, and very regular. The overlying and subjacent strata consist of various beds of sandstone and shale, intermixed with seams of coal. The mine is worked by the "bond and pillar" system, and the coal described by the owner as "a hard and splinty open-burning coal, free from sulphur, giving an intense heat, and leaving a small portion of white ash."

The principal markets are London, France, and the Baltic. The present current price is 7s. 6d. per ton.

The specimen of this coal which came into our hands was hard and splinty, with the lines of stratification less distinctly developed than in many of the coals from the same district. Its general appearance was bright and resinous, without either iron pyrites or white shale; but impressions of reeds of a silky appearance were sometimes observed in the jointings.

During the experiments, it was found to light easily, and blow off the steam rapidly. It also requires very little stoking, and leaves little ash, clinker, and cinder; but, like all the other coals from the north of England, gives off much smoke during its combustion.

Derwentwater's Hartley.

The Derwentwater colliery is situated at a distance of 1½ miles from the port of Warkworth, where the coals are shipped. The pit is sunk on what is called the Princess seam, which is supposed to be identical with the Low Main seam on the Tyne, and the Hutton seam on the Wear. Its width at this place varies from 4 to 5 feet, with a dip towards the south-west and north-east. The present depth of the workings is 75 fathoms.

The overlying and subjacent strata are composed of sandstone and shale, as is usual in the Newcastle district, and the coal is described by the agent as "hard and open-burning, giving a strong heat, leaving a white ash, and no clinker." The mine is worked by the "bond and pillar" system, and the coal chiefly used for the generation of steam, for which purpose large quantities are employed both in England and on the continent.

The present current price is 6s. 6d. per ton. In appearance this coal resembles that last described, except that it is not quite so brilliant, and contains more distinct marks of reeds, and, apparently, a larger amount of iron pyrites. It also behaves very much in the same way under the boiler, but is more smoky, and contains a larger quantity of earthy matter, which causes more ash and clinker to be produced than in the case of the Original Hartley coal.

Gadly Iron-work Coals.

Gadly's Aberdare colliery is situated at a distance of 24 miles from Cardiff, which is the shipping port. Two veins are at present explored in this mine:—

The first, or so-called Four-feet seam, is worked at a depth of 34 yards, and has a regular thickness of 5 feet, with an inclination of 3 inches in the yard towards the south. The overlying and subjacent strata are composed of strong shale. The mine is worked by "pit in the ordinary way," and the coal is described as free-burning.

The second, or Nine-feet seam, is mined at a depth of 90 yards from the surface; is regular, and has the thickness which its name indicates, with the same inclination, and in the same direction, as the Four-feet seam.

This coal is employed by the proprietors at their iron-works, for the various operations of that manufacture.

The specimens received at Putney College were rather soft, and possessed, in a remarkable degree, a radiate semi-crystallized appearance, together with polished faces in the partings, which seem to be produced by the sliding of one portion over the other, and which is often met with in the Welsh coal-fields. This was more particularly observed in the coal from the four-feet seam. The nine-feet seam, besides being more free from this appearance, contains bands of a dull friable substance, resembling mineralized charcoal, together with vegetable impressions and thin white shale.

Under the boiler little difference was observed in the burning of the coals from the two seams, as each gave a steady strong flame with no smoke, and left a large quantity of ash of a very incombustible nature, which, when again thrown on the grate, was found to choke the bars and interfere with the draught.

These coals were also found to require a strong draught in order to keep up a good fire. Little clinker was found on the bars at the close of the experiments, but that formed was of a red colour.

Aberdare Company's Merthyr.

This colliery is situated at Abernanty Groes y-chaf, Aberdare, Glamorganshire. The present depth of the mine is 45 yards, where the vein is regular, and 6 feet 6 inches in thickness, with a dip of 3 inches in the yard towards the south. The overlying and subjacent strata are composed of strong shale, and the coal is described as "free-burning."

This pit is 24 miles from Cardiff, where the coal is sold to Messrs. Wood & Co., who ship it under the name of Merthyr coal to almost every part of the world.

The specimen examined by the officers of this investigation was brilliant, with a cubical fracture, but presented in many places the peculiar radiate appearance before observed in other varieties of coal from the same district. It was also harder than the generality of Welsh coal, and apparently very free from white shale and iron pyrites.

Under the boiler this coal yields good results, burning freely and giving a good fire, which is easily kept up without much attention on the part of the stoker being required.

At the close of the experiments very little ash or clinker was left, and but little smoke was evolved during its combustion. Its evaporative power was also found to be good, and the coal in every way fitted for steam purposes.

Thomas's Merthyr.

This coal-mine is situated at Letty Shenkin, Aberdare, Glamorganshire, about 24 miles from Cardiff.

Its present depth is 120 yards. The seam has a thickness of 4 feet, with an underlie of 4 feet in the yard towards the south. The colliery is worked by shaft and headings, and the coal is described as "free-burning." This coal, like the preceding, is sold to Messrs. Wood & Co. of Cardiff, who export it from thence, under the same name, to almost all parts of the world for steam purposes.

The specimen sent up could not be distinguished from the Aberdare Company's coal, except that it was not quite so firm, and perhaps a little less brilliant. Under the boiler the two coals behave in precisely the same manner, but the evaporative power of that now described is a little superior to that of the other.

In a third article we shall conclude these experiments, with notes of the trials of ten additional specimens.

APPOLD'S CENTRIFUGAL PUMP.

This elevator, which we first noticed on its appearance before the members of the British Association in September last, is just now attracting some attention by its simplicity and efficiency. Although the idea has been some time before the world, its reputation has spread but little until very recently, when the Birmingham and Royal Cornwall Polytechnic meetings have done something towards an exposition of its merits. As it is only now being put into practical operation on the large scale, we cannot give full details of its construction, but, from the extreme simplicity of the apparatus, these may be easily worked out by any one who possesses the gist of its action.

The one erected on the premises of the inventor, in Wilson Street, Finsbury, London, having given off a fair amount of duty, may be taken as a good example of the machine.

Two circular sheets of thin metal, as copper or sheet iron, bevelled outwards towards the centre like shallow dishes, and having a centre-plate 6 inches diameter, are connected together by six angular fans or blades, passed through slots in the centre-plate, and soldered to the inside surfaces of the outer discs. This simple arrangement, placed in a water-elevating case, constitutes the whole arrangement. Fig. 1 of our engravings represents a sectional elevation of this form of the machine; fig. 2 is a side elevation of the elevating cylinder alone; and fig. 3 is one of the blades or fans. A A, Are the outer discs of the cylinder, fast on the shaft, B; and C C, are the fan-blades held by the outer discs and the central plate, E. These fans, six in number, are set at an angle of 45°, with the diametrical line of the discs. The driving-shaft has a bearing on one side only, where it passes through a stuffing-box in the case, F, which opens up into the bottom of a rectangular delivering-case, G. The openings round the periphery of the cylinder are 1 inch wide, and at the centre the outer discs are 4 inches apart. The water to be raised is admitted through central openings in the outer discs, and as the cylinder revolves at a high rate, it issues under the compulsory power of centrifugal force, by the circumferential openings, and is thence forced up the delivering channel to the discharge opening at H, which, in our view, is placed low down, to bring the illustration within a convenient space. The opening on the top of the case, F, is 9 inches by 7 inches, and the wooden case, G, which carries the water from it to the required height, is 10 inches square. The discharge-opening in this case is 6 feet above the water level, made so as to close when the water is to be raised higher up. The cylinder, with its case, stands in a cistern of water, 6 feet by 3 feet, and 3 feet deep, giving about nine gallons for each inch in depth. At a speed of 540 revolutions per minute, the discharge in this time was 1,093 gallons; this being all passed through an annular opening 1 inch wide by 38 inches in circumferential length.

Fig. 1.

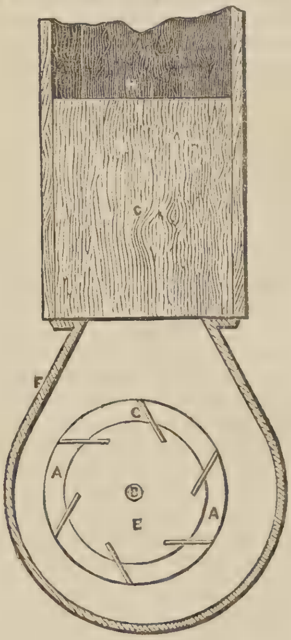


Fig. 2.

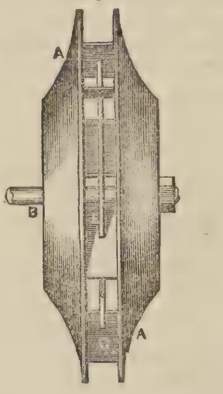
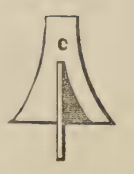


Fig. 3.

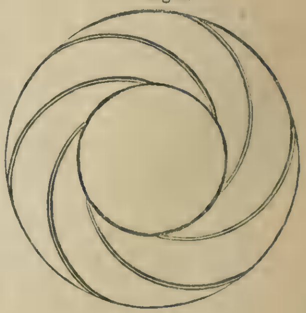


The pump is driven by a neat steam-engine, the shaft of which carries a 4-feet wheel, working a 6-inch pulley on the cylinder shaft by a gutta percha belt; and to check carefully the number of revolutions, the shaft carries an endless screw with a worm-wheel and index.

This is only one out of several arrangements which have received a trial. To ascertain the effect of an increase in the number of blades, the inventor tried twenty-four and forty-eight in place of six. In the twenty-four blade cylinder, the dimensions of the blades were 1⅝ inches across the face, and ½ inch deep; and at a rate of 809 revolutions per minute, the lift being 5 feet, 292 gallons were delivered; whilst, with a 2-feet lift, and 800 revolutions, 950 gallons were raised. With 48 blades, 786 revolutions raised 505 gallons 6 feet high; and 762 revolutions, with a 3-feet lift, gave out 1,072 gallons. This shows that twenty-four blades are superior to forty-eight, whilst the six-fan one performs double the duty of forty-eight, at two-thirds the rate of working. As these data refer only to small diameters, it is to be remembered that the great speed here given will not apply to the larger diameters of full-sized cylinders, where the increased circumferential length makes up for the rate.

In later modifications, of which the one we saw in Birmingham was one, the blades have been curved, as represented in the diagram, fig. 4, which is a side view of one of the discs, with the blades in their places. The sketch is supposed to represent a pump of 1 foot in diameter, with a width of 3 inches, the contents being one gallon.

Fig. 4.



1-12th.

The model is capable of discharging ten gallons of water per minute, and is only 1 inch diameter; one of the same shape, 12 inches diameter, will discharge at the same speed of the outside circumference, or 1-12th the number of revolutions, 1,440 gallons per minute, being according to the square of the diameter, and not according to the cubic contents. From various experiments, it has been found that the larger model with the curved vanes does the most duty, on account of its receiving and delivering the water more obliquely; it will discharge 1,800 gallons per minute, with 607 revolutions, but does the most duty at 535 revolutions, discharging 1,400 gallons; therefore, if a pump 1 inch diameter raises 10 gallons, and another, 1 foot diameter, 1,440 gallons, it follows that one—

10 feet diameter, of the best shape, will pump 140,000 per minute.
20 " " " 560,000 "
40 " " " 2,240,000 "

To do the above duty, the circumference of the 20-feet pump would be required to travel 560 yards per minute, which would be only 53½ revolutions, and the 40-feet 26¾.

From the results of various experiments, it has been found that the loss of power would not be more than 25 per cent. It will be observed that the centrifugal force is not so much in the large diameter, on account of the water moving more in a straight line; but that is compensated for by the force being applied to a greater depth of water, being 10 feet in the 40 feet, and only 3 inches in the 1 foot.

159 revolutions with the 1 foot will raise the water 1 foot high without discharging any.

318 revolutions	4 feet high.
636 "	16 "
1,272 "	64 "

The highest elevation to which the water has been raised with the 1-foot pump is 67 feet 8 inches, with 1,322 revolutions per minute, being less than the calculated height, which may be accounted for by leakage with the extra strain.

While the 1-foot pump is raising 8 tons of water 5 feet 6 inches high per minute, there is no greater strain on any part of the pump than 160 lbs. on the 6-inch drum, which is equal to a leverage of 3 inches—(see the results of various experiments.) It will pass almost anything that is small enough to go through, there being no valves. A quantity of nut galls—about half a gallon—were thrown into the 1-foot pump all at once, when it was at full speed, and they passed through without breaking one.

Table of Mean Results of various Experiments.

No. of revolutions per minute of 6 inch drum and pump.	Number of gallons raised 5 feet 6 inches high per minute.	Equivalent in lbs. raised 1 foot high per minute.	Strain in lbs. on a drum of 4 feet diameter driving one of 6 inches diameter, as measured by a dynamometer.	Equivalent strain on the steam engine, rated in lbs. raised 1 foot high per minute.	Per centage of work done compared with power expended.
400	500	27,500	74	44,400	61·7
412	600	33,000	80	49,440	66·7
427	700	38,500	87	55,723	69·0
440	800	44,000	94	62,010	70·9
453	900	49,500	100	67,950	72·8
474	1,000	55,000	106	75,366	72·9
481	1,100	60,500	113	81,479	74·2
495	1,200	66,000	118	87,615	75·3
518	1,300	71,500	121	94,017	76·0
535	1,400	77,000	126	101,115	76·1
563	1,500	82,500	134	113,163	72·9
580	1,600	88,000	138	120,060	73·3
595	1,700	93,500	142	126,733	73·6
607	1,800	99,000	150	136,575	72·5

Amongst the uses to which it is proposed to apply this elevator, the most obvious is as a drainage machine, where the lift is small—say from 4 to 8 feet. For this end it will no doubt be extensively applied by our colonial proprietors in Demerara, Trinidad, and Jamaica. Indeed, we know that it is about to receive a practical trial in several planting districts, the results of which we shall probably be able hereafter to chronicle.

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REVIEWS OF NEW BOOKS.

Portfolio of Lithographic Drawings of the Principal Articles of Manufacture, Exhibited at the Birmingham Exposition, 1849. T. Underwood, Birmingham.

The Birmingham Exposition has afforded Mr. Underwood some excellent examples for the display of his art; and in the thirty-seven sheets which form the contents of this portfolio, he has evidenced that he has not thrown away his opportunity. With the exception of one or two additional sheets at the end, the whole series are in the chalk style, on variously tinted grounds. The opening sheet is a well-drawn representation of Messrs. Minton's bas-relief of Prince Albert, in terra cotta. This was one of the most striking objects of the Exposition, and the beautifully-modelled supporters have lost none of their spirit in their transfer to the lithographic stone. Some drawing-room fire-grates, the contributions of Mr. Herbert Room, and one of which is from a design by Mr. Harry Rogers, are here also admirably reproduced. The same may be said of a very different class of subjects—a set of carvings by Messrs. Taylor, Williams, and Jordan, the fine parcel of game in which attracted universal attention. In glass manufactures, we have the magnificent candelabrum of Messrs. Osler, with a fair show of many of the smaller, but equally beautiful, works in glass, by various other makers.

One of the most elegantly classical sheets, is that devoted to some examples of vases and a cabinet of Messrs. Walton of Wolverhampton, the effect of which is heightened by a peculiarly dark-tinted ground.

Here and there are signs of harshness, and a want of due tact in the management of the chalk, which causes an appearance of hardness and rigidity of outline; but as a whole, and considered in reference to the difficulties attending this particular style of representation, the drawings are deserving of the title—artistic.

The mechanical department of the Exposition is here only feebly represented, no more than four sheets being devoted for this purpose. In these are a perspective view of "Fourdrinier's safety apparatus for preventing accidents in mines and collieries," no doubt well known to most of our readers; Mr. Knight's ingenious numbering-machine; Mr. Heaton's apparatus for balancing locomotive-engines; Mr. Isaiah Davies' rotatory engine; and a series of woodcuts, with letterpress description, of "Cotterill's Climax Detector Locks," extracted from the late pages of the *Practical Mechanic's Journal.* As a souvenir of the Birmingham meeting, this collection will be found most acceptable to its many visitors; whilst, to absent admirers of art, it may serve to convey a notion of the realities they have missed.

Rudimentary Dictionary of Terms used in Architecture, Engineering, Surveying, &c. Parts I. and II. Pp. 276. Woodcuts. By John Weale. London, 1849–50.

In his preface, Mr. Weale tells us that "it was intended that the contents of this work should be comprised within the space of about 150 pages, and thus form a single volume of the series of 'Rudimentary Treatises;' but in the course of its compilation, it soon became apparent that such confined limits were wholly inadequate to the admission of explanations of terms, which, although not immediately connected with the subjects mentioned in the title-page, were yet deemed essential to their further amplification."

We have here a pretty fair confession of an error to which we have before referred, in connection with Mr. Weale's laudable attempts to disseminate good matter, cheaply, in his "Rudimentary Treatises." However much we may wish for the amplification of the mechanic's chances of obtaining practical knowledge, in the way Mr. Weale and one or two of his fellow-publishers have pointed out, we are constantly reminded that there are many subjects which it is worse than useless to try to bring within the range of shilling volumes, and the present production is an instance of what we mean. It is a double or two shilling part, stopping short at letter M; so that a second part of the same extent, at least, will be necessary to get through the alphabet.

To show the pretensions of the book, we have to explain that its title-page intimates its contents to be the terms used in "Architecture (Civil), Architecture (Naval), Building and Construction, Early and Ecclesiastical Art, Engineering (Mechanical), Fine Art, Mining, Surveying, &c.," and we appeal to any one who is at all practically informed in the technicalities of any of these branches, whether it is possible to detail even a tithe of the mass of terms to be found in even one of them, in the space which Mr. Weale has allotted for the purpose.

Under the letter "Abbey," is given a useful collation from Dugdale's 'Monasticon,' which may be referred to with advantage, by the architect and antiquarian. To our thinking, the architectural terms preponderate somewhat unduly; and although those in connection with engineering are generally given with a practical conciseness, their paucity is matter for regret. We give the definition of civil engineering as an example of the style of treatment:—

> "Engineering, Civil. This profession may be said to have originated in England about the middle of the last century. Before that period, whenever the prospects of great profit induced individuals or bodies to incorporate themselves for the purpose of undertaking extensive systems of drainage, or for the supply of water, requiring the assistance of an engineer, recourse was generally had to those great masters of hydraulic engineer-

ing, the Dutch. True it is that some solitary exceptions have occasionally been found; men who, like Sir Hugh Myddelton, combined a speculative turn of mind with some mechanical knowledge, and to these two qualities added an untiring energy of purpose, leading them to persevere in any undertaking, even under the most discouraging circumstances. But these men were rare instances of a peculiar talent, which, though it thus displayed itself occasionally, was far too uncommon a gift to allow the possessors of it to form a class or profession. The case is very different now: a demand for this peculiar talent has been created of late years by the extraordinary development of our system of internal communication, as well as by the application of steam to the purposes of our manufactures; and employment is now found for hundreds where one was sufficient, not fifty years since, for the whole business of the country. So great indeed has been the demand, that the profession may be said to be divided into two distinct bodies, viz., those who turn their attention to subjects which come more particularly within the scope of the duty of a civil engineer, such as docks, bridges, canals, railroads, &c., aud those who devote themselves altogether to the manufacture of machinery. The duties which are involved in the practice of these two branches of the profession, though apparently dissimilar in character, are yet founded upon the same general principles; and the acquirements which are necessary to enable the individual of one class to distinguish himself, or even to practise his profession with a moderate chance of success, will be found equally necessary for those of the other class.

"These acquirements are partly abstract and theoretical, and partly experimental or practical. A civil engineer should, in addition to the knowledge required to fit him as well as others for the active duties of life, have such a knowledge of mathematics as will enable him to investigate as well as to apply the rules laid down by writers on those branches of the mixed sciences to which his attention will most frequently be drawn. He should be well acquainted with the principles of mechanics, hydraulics, and indeed with all the branches of natural philosophy; and a certain amount of chemical knowledge will be found very valuable: he should be able to draw neatly, and should understand the principles of projection upon which all engineering drawings are constructed: a general knowledge of the principles of architecture will also be essential. Having acquired the requisite amount of theoretical information, the next step is to gain that practical knowledge which is essential in order to the proper application of this information. The best mode of gaining this experience is to enter into the employment of some eminent man in the profession, in whose office there will be every opportunity offered to the young beginner of witnessing the mode in which the various descriptions of work are carried on. He will there be employed, first as a draughtsman, in copying drawings: as he becomes more acquainted with practical details, he will have more responsibility thrown upon him, and be placed in charge of works, at first of small importance, but, by degrees, of those of such magnitude as will require all his theoretical knowledge, and all the practical experience he may have gained, to enable him to carry out the work to the satisfaction of his employers: he should cultivate a habit ot observation, and make a point of taking ample notes and sketches of whatever he may see which in any way bears upon his profession. Having thus by degrees acquired a sufficient amount of information to give him a confidence in his own judgment upon any subject which may be submitted to him, and having become known as an active and intelligent agent of others, he will very possibly be called upon to plan and execute a work himself, and then, by degrees, with industry and activity, may work his way upwards in *a profession where merit alone can lead to distinction*.

"The course of the man who devotes himself to the machinery branch of the profession differs but little, up to a certain point, from that just described: his theoretical acquirements should be the same, but the practical part of his education will commence at the bench, where he will learn the use of all the tools and machinery by working at them with his own hands: he will then be placed in the drawing-room, and go through much the same routine of instruction as before described, and will, by degrees, work his way up to the position of foreman; then, distinguishing himself by a power of applying general principles to particular cases, he will show himself capable of assuming the direction of an establishment for the manufacture of machinery."

A few well-executed woodcuts add something to the lightness of the pages; and the book, as far as it goes, may usefully occupy a corner of the professional man's bookcase.

Examples of Iron Building and Roofing. By John H. Porter. Plates. London, Day & Son, 1849.

Our earlier pages have afforded some evidence of the successful efforts of Mr. Porter, in his applications of iron to the construction of buildings and roofs, under the galvanized corrugated form, and his present "Examples" further illustrate the extent to which these applications have been carried.

Since the introduction of M. Sorel's invention of zinc-coated iron, the use of this metal in buildings has rapidly extended in this country; and we believe we are correct in stating, that this extension is mainly owing to the exertions of Mr. Porter's father, who was the first to adapt the galvanized material to roofing purposes here. This was in 1843, and in the following year he added the principle of corrugation, and constructed a building to serve as a dwelling and warehouse for a merchant at Hong-Kong, and introduced roofing-plates of the same material, instead of shingling, as a covering for timber-roofs, in Ceylon and the West Indies.

The "Examples" now issued are comprehended in twelve well-executed lithographic plates, by Day & Son, showing the corrugated principle applied to roofs of several kinds, as well as in some cases to the shells of the buildings themselves.

These are a coffee-shed at Ceylon, with corrugated roofing-plates upon timber framing; an iron carriage-shed for the Great Western Railway; and another for the Patent Fuel Company at Swansea; iron-roofed farm-buildings at Tetwood, near Southampton; megass-sheds, and a church roof at Montpelier, Jamaica; a centre roof at the Western Gas Works, Kensal Green; the Waterloo station of the London and North-Western Railway at Liverpool; a store and cottage at the Cape of Good Hope; a sugar factory at Barbadoes; a railway warehouse at Chertsey; and the market-house at San Fernando, Trinidad. The last subject was fully detailed in our first volume, and, in his descriptive text, Mr. Porter has quoted our accompanying remarks made at the time.

Mr. Day's drawings appear to have done full justice to the designer's ideas, for a further elucidation of which, we may refer our readers to the book itself.

Problems in Astronomy, Surveying, and Navigation, with their Solutions. By H. W. Jeans, F.R.A.S. Pp. 289. London, Longmans, 1849.

Rules and Examples in Navigation. By the same Author. Pp. 182.

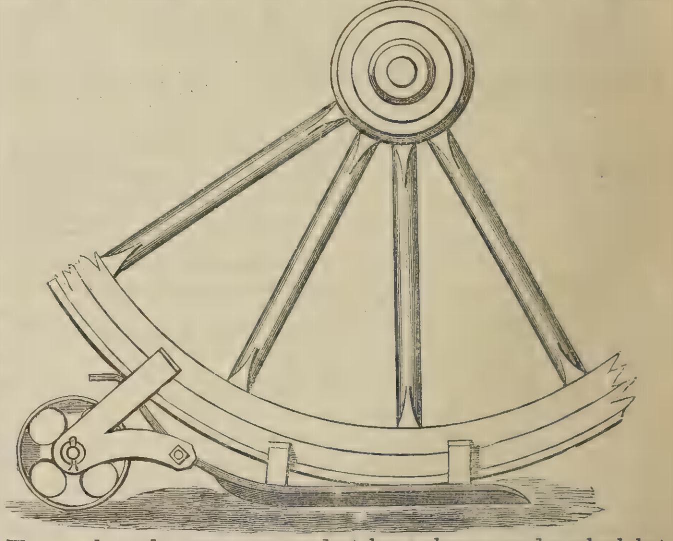
By introducing these small volumes to the notice of the student, we hope to render him an efficient service by the same action which accords to the author that credit which is so emphatically his due, for long-continued exertions in the production of standard text-books. The great object of facilitating self-instruction, stands pre-eminent in the framing of the present works; and when we state that Mr. Jeans has in every respect acted up to his proposition, it is unnecessary for us to urge anything further in recommendation of the volumes.

The *Rules* and *Examples* are an off-shoot from the larger volume in which they originally appeared, having been so laid out at the instance of several naval instructors, who have adopted them as examples for their pupils in navigation. One point worthy remarking upon is, that the *Rules* have been drawn up in two forms, to suit two distinct classes of students—the mathematical, and non-mathematical. This is an important feature, which deserves more general adoption.

CORRESPONDENCE.

STRATTON & HUGHES' CART-WHEEL AND DRAG-SHOE.

Observing in your journal of this month a notice of a wheel drag-shoe, met with by your clever correspondent in his journey "along the South Devon Railway into Cornwall," I send you a sketch of one entirely of iron, manufactured by Messrs. Stratton, Hughes, & Co., of this city.



The one shown by your correspondent has a clumsy wooden wheel, but the present form of the cart-wheel drag-shoe is at any rate not open to the charge of inelegance or superfluous weight. As your correspondent speaks well of this contrivance, it may interest you to know that they are much used in this part of the country, and throughout the west of England.

Enquirer.

Bristol, 24th Nov., 1849.

BURN'S ROLLER-GIN.

Allow me in explanation to inform you, in reference to the concluding remarks you have made on the roller-gin, which you saw on trial at Mr. Thomson's cotton factory, that that machine was incomplete, and required to have a guard placed over the upper roller, to prevent the thick layers of seed-cotton choking the rollers, when not carefully fed.

With regard to your observations about the length of the rollers being too short for an efficient delivery of cotton, I beg to inform you that 150 lbs. of seed-cotton can be cleaned in the day by 12-inch rollers, and, if driven at a high speed, a larger produce might be obtained. I am informed by a correspondent, that 180 lbs. in the day is cleaned in Egypt by the Arabs. The small amount of power required to drive these machines makes this a very fair result. A boy will keep up the supply of cotton to several machines. The springing of the steel roller does not prevent the lengthening of the rollers if desired, as the seed is not now brought in contact with the steel roller, as stated by you. The machine you saw was made of small size, being intended to be worked by the hand.

I must agree with you, that the produce of the above class of machines is far short of what is required, but we have no others applied to the cleaning of cotton abroad except the saw-gin; and this machine has been found on trial to be unfit for all kinds of cotton except the American, every other kind being cleaned by rollers, generally driven and fed by the hand.

Robert Burn.

[We were given to understand that the experimental machine referred to was full-sized, and in every way complete; and therefore, in giving our opinion upon it, we treated it accordingly. If Mr. Burn brings forward an incomplete example, he must not quarrel with us for telling the truth about it. Our remarks were confined entirely to what we saw. If the machine, as now made, is different from the one commented on—and his note leads to this inference—it may demand a more favourable notice. When opportunity offers, we shall be glad to credit it for any superiority which it may be found to possess.—Ed. P. M. J.]

WANTS.—A WRITING COUCH, AND PRESS FOR DRYING PLANTS.

Can any of your readers furnish me with the design of a couch, or chair, which shall afford to a person engaged in writing the greatest possible amount of ease as regards position? It should be furnished with a table, or desk, removeable at pleasure. It appears to me that a reclining attitude would be the easiest; but there is always a difficulty in making the ink flow to the paper when the pen approaches the horizontal.

An Invalid Author.

Can you, or any of your readers, inform me what is the best kind of press that a person, travelling from place to place, can use for drying plants, for a herbarium, or hortus siccus? I wish to combine portability, smallness of bulk, and the power of readily increasing or diminishing the pressure.

A Botanist.

YATES' DEAD-BEAT HALF-SECONDS WATCH.

I perceive, in your June number, a letter from Mr. Leonard of London, in which he comments upon a supposed misconstruction of my dead-beat watch escapement. I think, however, that no one will infer from the wording of the explanation which accompanies my drawing,* that one pallet should be circular and the other not; but, upon a close investigation of the illustrative figure, I find that the inside pallet is not circular, and so far it is incorrect. Both of the resting parts of the pallets ought to be alike circular, as your correspondent intimates; and when the proper circular contour is adhered to, all the evils of recoil are removed, securing the advantages of a real dead-beat escapement, moving with all the steadiness and uniformity of a well-finished chronometer. Indeed, it is somewhat of a treat to a scientific man, to see with what steadiness the seconds hand moves.

Thomas Yates.

Preston, December, 1849.

[We have compared the description with the drawing, and find, as Mr. Yates remarks, that Mr. Leonard has been misled by a slight inaccuracy in the latter. The drawing was copied from that of the inventor; and the error on our part, if it is to be called one, extends just to this, that we did not detect the very slight discrepancy in the form of the pallets. We hope we have now finally set at rest the question as to the escapement being a true dead-beat; and, besides this, we happen to be in a position to state, that watches to which it is applied are most trustworthy in regard to their evenness of rate.]

ROBERTS' SIGNAL FOR RAILWAY TRAINS.

In your Journal for the present month, I perceive a notice of "Roberts' Signal for Railway Trains." Mr. Roberts is certainly the patentee of the signal in question, but he is by no means entitled to the whole merit of the invention.

His patent also is a dead letter, for the following reasons:—1. The principle of action which he claims is not new, Mr. Allen of the Putney College, having, some months previous to the date of Roberts' patent, published a similar invention, by exhibiting it at the Institution of Mechanical Engineers at Birmingham, October 27, 1847; Roberts' patent being dated February 28, 1848. He (Mr. Allen) also exhibited it at the Society of Arts, and obtained for it the society's gold medal—(see P. M. Journal, vol. i. p. 93.) 2. Because his specification contains more than is his own invention.

I admit Mr. R.'s claim to credit for his idea of applying an electro-magnet to work the steam-whistle, if such idea was *original*, which, from the above dates, is, to say the least, open to be questioned. But all of simplicity and efficiency that the instrument possesses, I distinctly claim and can prove to be my invention. Like the boy and the filberts, Mr. R. in grasping too much has lost all; and were the invention of the slightest commercial value, I should not hesitate to make what use of my part of it I might think proper. "*Palmam qui meruit ferat.*"

John Tebay, C.E.

London, December 10, 1849.

WILLIS'S FARMER'S ENGINE—AND STEAM PLOUGHING.

Allow me to communicate, by means of your periodical, an idea respecting the application of steam to agricultural purposes, which has, at intervals, for some months occupied my attention. I do so now, because the publication in your journal of this month, of an account of "Willis's Farmer's Steam-Engine," presents a good opportunity for trying, without much expense, the practicability of my notion.

Your pages are not the arena for political disputation, yet I may venture to remark, with Lord Kinnaird, that "high farming" is now the only means by which our agricultural system can be brought into a healthy and prosperous condition. There is little hope that the free-trade measures, which are now really telling upon the farmers, will ever be repealed. It is, therefore, absolutely necessary that the talent which has placed our manufacturing interest in its prominent and proud position, should now be enlisted in the cause of the farmers, so that chemistry and geology, meteorology and mechanics, may lend their magic and powerful aid, to make two blades of corn grow where but one had heretofore raised its head, and to fatten upon the same area of land a double amount of sheep and oxen.

My notion is a steam plough. The idea is old, but the means of its application—the *modus operandi* which I shall mention—has not, so far as I am aware, yet been noticed. I had the suggestion from seeing a subsoil machine at work. This instrument—made, I believe, by Crosskill—consists essentially of a wheel somewhat larger than the travelling wheels, and fixed to the same axle. On the periphery of this wheel are fixed a number of curved iron spikes, which, as the machine is drawn forward, revolve and penetrate the earth, raising it up. This machine, I am told by those who have tried it, is very useful, and so loosens the earth as to make it comparatively easy to plough afterwards. Let, then, one of these instruments be fixed to the driving axle of Willis's engine. The spikes will answer the double purpose of raising and breaking the soil, and of enabling the engine to travel up hills which it otherwise would not do. Close behind this spiked wheel, and in a line with it, let a plough be fixed, which may be of the ordinary shape, and it will be of more than ordinary efficacy in turning up a deep furrow. From the land being broken up and loosened, the plough, with the same amount of power, would take a much deeper hold than is practicable in our usual mode of ploughing. It may, however, be necessary to attach the wheel to an axle, which shall be connected with the driving axle by spur wheels, and made to be raised up when the engine is otherwise employed than in ploughing.

I leave, however, these details to the superior judgment of those gentlemen who have possession of the engine, and who will, I hope, be induced to try the experiment, seeing that the expense will with them be so very trifling, while the vast boon it offers is such as to warrant great efforts being made to accomplish the end in purpose. If you think well of these suggestions, will you please to give them publicity, and also use your own eloquence and influence to urge a practical application of them?

R. E. R.

Hexham, Dec. 3, 1849.

[As our correspondent has so politely requested us to make some addition to his ingenious remarks, it would be ungracious to refuse him; and yet, after so many discouraging failures of attempts to apply steam mechanism, as it *now* exists, to agricultural purposes, it is difficult to see our way. On some land, the combination he proposes might answer to a certain extent, but a few moments' consideration of the weight and action of the steam-engine in its present condition, in connection with the loose, heavy, and uncertain surface of arable ground, leaves little hope for a successful issue of such an attempt for general purposes. Perhaps the present holders of the "farmer's engine," or their fellow-promoters of the steam system of cultivation, will favour us with their ideas on the point.—Ed. P. M. J.]

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* Page 9, for April last.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

November 13, 1849.

In accordance with the resolution of a special meeting of members, the session of the Institution commenced on Tuesday evening, instead of, as heretofore, in the middle of January. This is a great improvement, as it assimilates the routine of this useful society to that of other scientific bodies. It will also prove very convenient to country members, give a greater number of meetings, and enable the session to terminate brilliantly with the president's Conversazione.

The paper read was a "Description of the Coffer-dam at the Grimsby Docks," by Mr. Charles Neate, Assoc. Inst. C. E. It commenced by briefly noticing the importance of preliminary structures in all works of hydraulic engineering, and the difficulties generally attending their execution. The position of Grimsby, on the south shore of the Humber, was then described; its proximity to the sea, the natural shelter afforded by the opposite shore of Spurn Head, and the various advantages it presented for the construction of extensive docks.

A general description followed of the enclosure made for the purpose of the dock-works, which comprised an area of 138 acres, and projected five-eighths of a mile beyond the margin of the high-water line of the shore. It was explained, that the flatness of the coast necessitated this great projection, as it was requisite to found the new entrance locks in the low-water channel of the river, in order to secure, at all times, a sufficient depth of water for large vessels. These conditions regulated the position of the coffer-dam, which stood in a very exposed situation, and was entirely self-supported. Its principal features were stated to be its extent, and the form of its construction. The length of the coffer-dam was 1500 feet, supporting, at high-water, a head of water of 25 feet; whilst the excavation behind it was carried to 11 feet below low-water. The form of the dam was that of a circular curve, with a versed sine of 200 feet, or nearly one-fifth of the span.

Several of the constructive arrangements were peculiar. The work consisted of a triple row of whole timber sheet piling, which derived interior support from counterforts, or buttresses, of solid sheet piling, driven at intervals of 25 feet throughout its length. The long or through bolts were made to break joint and terminate at the middle row of piling, so that no water could pass along them through the dam. In the middle row of piling, wrought-iron plating was substituted for timber walings, which formed excellent longitudinal ties, and left an uninterrupted surface on the piling, against which the puddle would lie compactly.

It was stated that these arrangements had imparted an extraordinary degree of stability and tightness to the structure, which had resisted the effects of storms, and the pressure of the tides, in the most perfect manner, during a period of fourteen months.

A portion of the ground, between the works and the shore, was described as being of a soft, silty clay, probably the site of an old channel; and as it was found, after all precautions, impossible to raise any solid structure upon it, the alternative was adopted of displacing it completely, by raising a bank of chalk-stone rubble, which sunk down to the hard bed of clay beneath. This method was successful in forming a very fine embankment.

The abundant supply of water from Artesian wells in Grimsby was adverted to, and referred to the vicinity of the chalk hills.

The conclusion of the paper drew attention to the magnitude of the masonry works now advancing at Grimsby, and for the formation of which the coffer-dam was erected, and which, when completed, from the designs of Mr. Rendel, the chief engineer, and under the superintendence of Mr. Adam Smith, the resident engineer, will form, perhaps, one of the most useful, as well as the most important, maritime works of modern times.

November 20, 1849.

The discussion upon the Grimsby docks being continued, the speakers, led by the Very Rev. the Dean of Westminster, in his usual able and energetic manner, were induced to diverge very widely from the original subject, to point out the acknowledged advantages that would result from engineers possessing a more accurate knowledge of geology, and being able to discriminate between strata by an examination of the component parts, and to decide upon their origin, as a guide in judging of their capability of supporting the weights likely to be placed upon them in the construction of works.

The Rev. Dean gave many instances where, in his opinion, more accurate geological knowledge would have secured greater success, or have prevented casualties. He quoted particularly the borings and the report said to have been made previous to the commencement of the Thames Tunnel, and the recent statement that the projected tunnel for receiving and conveying the sewerage of London down to the Essex marshes, would, throughout its entire length, have been in the London clay. He showed, however, that no London clay was to be found eastward of St. Paul's, and that the plastic clay was constantly mistaken for it, in consequence of the observers not possessing a sufficiently accurate knowledge of the difference in the constituent features of the two clays.

On the other hand, although it was admitted that an accurate knowledge of geology was most valuable to engineers, it was contended that they were not so ill-informed on the subject as had been assumed. They did appreciate the necessity of that knowledge; and although they might not be able to discourse upon it with the eloquence of a Buckland, a Lyell, or a Sedgwick, or to speculate so plausibly upon the events of past ages, no careful engineer ever decided upon the position, or mode of construction of his works, without a series of trial borings, a careful examination of the specimens, and experiments on them, chiefly with the view of ascertaining their strength, or capability for sustaining weights. Instead, therefore, of accusing engineers of knowing so little, it was rather a subject of surprise that they knew so much; for no profession demanded such varied acquirements, or the exercise of such general common sense and judgment.

It was shown that the position of the Thames Tunnel was not determined by the report, or the results of the borings, but with a view to establishing a connection between particular localities. The borings were perhaps inefficiently made, as compared with those of the present day, with the improved apparatus now in use; but Mr. I. K. Brunel had made a very complete series of borings across the Thames, showing most accurately the strata of the bed, and no errors could have been induced by them.

The statement of the proposed sewer tunnel being in the London clay, never had been accepted by eminent men who understood their profession, however it might have been argued upon, as an assumed fact, by Commissioners and Boards of Sewers.

The discussion was closed by the Dean of Westminster giving an example of the urgency for engineers becoming geologists; and on Mr. Rendel stating, that the clay at Leith was so hard as to require to be blasted, and yet that, when exposed to a small current of water, was completely dissolved within a fortnight, he at once explained it as arising from the presence of a multitude of minute particles of mica, whose non-adhesive properties produced the speedy disintegration of the mass. This was admitted to be the fact, and had been observed and allowed for by the engineer in the construction of the works.

November 27, 1849.

"Description of the Old Southend Pier-head, and the extension of the pier; with an inquiry into the nature and ravages of the 'Teredo Navalis,' and the means hitherto adopted for preventing its attacks," by Mr. John Paton.

After describing the form of construction of the old pier-head, and showing the adoption of copper sheathing for protecting it from decay, and the important considerations involved in the attempt to preserve marine structures, the paper explained the ravages committed by marine worms ("Teredo Navalis," "Lymnoria Terebrans," and others) on the piles, both above and below the copper sheathing. This sheathing extended from the top of the mud to three feet above low water-mark; the worm destroyed the timber from two feet below the surface of the mud, to eight feet above low water spring-tides; and, in fact, out of thirty-eight fir timber piles, and various oak piles, not one remained perfect, after being up only three years; indeed, some were entirely eaten through.

A general outline of the extension of the pier, and a minute description of the pier-head, were then given, showing the means adopted by the use of iron piles, and by scupper-nailing the inner piles, to preserve the structure from decay. The greater portion of the extension of the pier, the length of which was one mile, as well as the whole of the pier-head, were constructed of square, hollow, iron piles, and scupper-nailed fender piles; the iron piles being forced to a depth of from eight feet to sixteen feet, by pulling them backwards and forwards with ropes attached to them, and not by driving in the usual manner; they were then filled with gravel and concrete to within five feet of the top, and the fir piles to sustain the superstructure were fitted into them. The pier-head was constructed with forty cast-iron piles, and twenty fender piles, nailed from five feet below the bed of the sea to eight feet above low water; its greatest height was twenty-five feet above low water spring-tides.

The paper then entered into an investigation of the nature and operations of the "Teredo Navalis," and showed, as a remarkable peculiarity, that no chemical means had hitherto prevented wood from being destroyed by these animals and the "Limnoria Terebrans," whose destructive powers were likewise noticed, and as having penetrated between the copper sheathing and the wood at Southend. The operations of the "Teredo," although most destructive in warm climates, extended themselves to all places, having been found almost in the Polar seas.

The chief peculiarities which distinguished the "Teredo" were stated to have been ascertained by minute microscopical investigation, and that woody fibres of an extremely minute nature had been discovered in the body, thus setting at rest the question as to whether the "Teredo" did actually feed upon the wood. It was stated, that the failure of chemical means to preserve timber from destruction by the marine worm was believed to proceed from two causes,—namely, of poisonous compounds having no seriously injurious effect upon them, and the sea-water, and other things, decomposing the poisonous ingredients contained in the wood. In corroboration of the first of these views, accounts of experiments made by Mr. Paton were adduced; and physiological facts, quoted from the *British and Foreign Medical Review*, were brought forward to show, that cold-blooded animals were much more tenacious of life than those of a higher temperament; and hence it was argued, that, as it required a very large quantity of poison of the most virulent nature, to destroy animals of a much higher order than the "Teredo Navalis," it would take a still greater quantity to affect those animals as they existed in their own element; and it was questioned, under these circumstances, whether wood could ever be so completely and thoroughly saturated, as in any degree to affect them. The corrosive action of the sea-water, its extended influence and constant variableness in different parts of the globe, were then commented on, and some of the various salts held in solution mentioned. It was believed to be impossible to form any general notion of the precise action of sea-water on timber, whether chemically saturated or not, without a series of most minute experiments, and a large body of facts, carefully collected in different parts of the globe—as that which might be advantageously used in the Thames, might not be of the slightest avail in the tropics, and *vice versa;* it was thus questioned, whether any generally applicable principle could be found for the counteracting of that universal solvent of soluble matter. The conclusions arrived at were, that the ravages of the marine worm were not prevented by any chemical application, and that nothing but mechanical means could ever prove completely successful; studding with broad-headed nails was considered to be the most effectual remedy, and various authorities were quoted, proving its success. The paper concluded with a list of places where wood, prepared with various chemical ingredients, had been destroyed from various causes.

The discussion was commenced by the Dean of Westminster, who descanted very lengthily on the analogous action of the Pholas on stone.

SOCIETY OF ARTS.

President—H. R. H. Prince Albert, D.C.L., F.R.S., &c.

November 7.

The usual address from the Council, for the present year, shows that the ordinary revenue of the society has increased in seven years from £800 to £1,600; the whole of which is directly expended in the promotion of arts, manufactures, and commerce. It is a remarkable feature in the present state of the society, that it now expends no more money upon its establishment of officers and servants than it did in 1841, when its condition was the reverse of prosperous. The present list of fifty-eight candidates for election as members, may be appealed to as an event altogether without precedent in the history of this society, and attests its growing power and usefulness.

The council have during the session issued a prize-list for 1850, in its various departments of agriculture, arts, mechanics, and manufactures, in which it will be observed that upwards of £600 worth of premiums and medals are offered for competition; and it is a matter for congratulation that at the head of the list stand the two gold medals of H.R.H. the President. The admirable exhibition of paintings which clothed the walls of the great room during the summer, was visited by thousands of persons, who then saw for the first time these great historical paintings; that, until that exhibition, Mr. Etty's transcendent merits were only fully appreciated by the limited circle who had hitherto been fortunate enough to see his greatest works. The council think it right to express once more their sense of the liberality and enlightened zeal for the promotion of art, with which Sir William Allen, the President of the Academy of Painters of Scotland, and the members of the council, allowed their great works to be exhibited here for the first time; and to all the possessors of these paintings, public thanks are due for their liberality and readiness in sending them for exhibition. It is a matter of pride to this society that they have already been the means of making better known to the public the character and genius of two living painters so distinguished as Mr. Mulready and Mr. Etty.

In reference to the approaching Exposition, extracts from Mr. Digby Wyatt's report on the Eleventh French Exposition of the Products of Industry were read. This report—after alluding to the attention paid by the French government to the development of the manufactures of that country by precept, example, premiums, public exhibitions, elementary schools, societies of encouragement, &c.; to the traditional excellence of early French productions, and to the modern restoration of that supereminence, by the means before-mentioned, now persevered in, with few interruptions, for fifty years—was divided into three parts.

The first, embracing the details of construction, cost, and arrangement of the building, which may be thus briefly described:—

It was situated on the Carré de Marigny, abutting on the Champs Elysées; thus, as a site, offering every possible advantage.

The whole plot covers a vast parallelogram of 675 feet by 328, being about 5 acres; round the outline of which runs a gallery 90 feet wide, divided into two avenues by a double row of pilasters. In the centre of each avenue is a set of stalls for the exhibition of merchandise. And both between the pilasters and round upon the walls, other objects are placed; so that, in traversing either of the four gangways, the public have on both hands objects for inspection. The parallelogram thus enclosed is divided by two transverse galleries, similarly arranged to that already described, forming three court-yards; the central being 140 feet square, and the two lateral 80 feet by 140.

The central court-yard is open, and in the middle an elegant fountain. Around are sheds for the exhibition of flowers and horticultural ornaments and implements. One of the lateral courts (enclosed) contains the objects in metal, cast-iron, &c.; and the other an immense reservoir, in which all the drainage from the roofs is collected, so as to form a supply of water immediately serviceable in case of fire. In addition is constructed a vast shed, of a length rather greater than the width of the great parallelogram, and about 100 feet wide, for the exhibition of agricultural produce. A long narrow gallery intervenes between it and the main building. The whole of the building is constructed of wood, the roofs being covered with zinc, of which nearly 4,000 tons have been used, and nearly 45,000 pieces of timber. By the plans (suspended in the great room), to which the author specially referred, was fully explained the foregoing description, and that an unnecessary expenditure had been gone into. Carton pièrre trusses apparently support the timbers, and a painted bas-relief fills the tympanum of the pediment at the principal entrance. The architecture of the whole is *mesquin.*

Mr. Wyatt stated that the Exposition

Of the years	Contained an area of square yards as under.	Cost of the building was:		The expenses of transporting the goods to and from Paris.		The cost of rewards.		The total cost o the Exhibition.	
		£	s.	£	s.	£	s.	£	s.
1839	13,583	14,551	12	4,847	0	2,429	12	21,828	8
1844	23,310	14,056	14	5,641	16	3,238	0	23,937	4
1849	27,214	16,000	0	Not yet made up.		Not yet		made up.	

To this amount for the present year must be added £2,000, the cost of the agricultural shed, making the whole sum expended £18,000. It must be remembered that this money is paid only for the hire of the materials for about three months, the whole remaining the property of the contractor at the termination of the exhibition.

And arrangements as to classification of products of the last Exposition. After touching briefly on the classification of products in former years, Mr. Wyatt proceeded to give that adopted by the jury in 1844. They divided the manufacturing arts into—

1. Woven.
2. Mineral.
3. Mechanical.
4. Mathematical.
5. Chemical.
6. Fine.
7. Ceramic.
8. Miscellaneous.

Arts on the accidental or natural system.

This arrangement led to confusion.

In 1849, no systematic classification appears to have been adopted, convenience of arrangement, rather than the nature of the product, being considered. The great uncertainty of the uniform supply of goods from year to year, renders it extremely difficult to complete any preliminary arrangement. Thus, machinery, which in 1839 was comparatively a minor item, is in 1849 a great and predominating attraction. The products of Mulhausen (cotton and mixed goods), which in 1839 required a large hall for themselves, sunk this year into the ordinary space required by other branches. It is in articles of taste, however, that French workmen exhibit their greatest strength. We scarcely ever see a piece of bad ornamental modelling. The human figure is rarely ill drawn, and we recognise everywhere a practised hand and a thoughtful head. With a few exceptions, the French are before us in every ornamental art; and in machinery also they have this year displayed their power in mechanical resources to an extent that would be alarming, if we were not ourselves in a state of continual progress. Mr. Wyatt also alludes to the excellent liberality of the French government in the whole expenditure; to the perfect arrangements for free ingress and egress, and for unanimous movement. The catalogue contained a double series; and the exhibitors were allowed, with great advantage, to fit up their own stalls. The goods, however, on the whole, wanted arrangement; and the building had the defect of containing no one grand hall, whereas, on the occasion of distributing prizes, a great assemblage might take place. Mr. Wyatt believes that a better building might be erected in England at a much less cost, probably by one-fourth.

The second contains a history of all the past Expositions, from the original idea of the Marquis d'Avèze, in the year 1797, down to the present time; and a table is given, showing the general conditions of many of them.

The third explains the official arrangements by which the Minister of Agriculture and Commerce is required to carry out each exposition. The institution of a central jury for awarding the prizes is said to have worked well; that jury consisting of retired merchants and manufacturers, professors, engineers, and men of science, of a reputation and standing sufficiently high to place their verdict above all question.

The appendices consist of various papers, by means of which the formulæ of correspondence, &c., are conducted; and No. 4 contains the decree by which the last Exposition was announced to the public.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE—NINETEENTH MEETING.—Birmingham, Sept. 12, 1849.

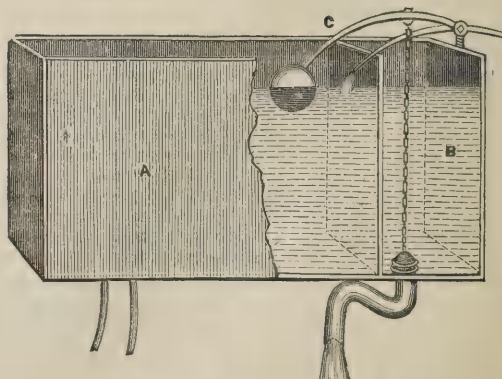
Section G.—Mechanical Science.

"On the Superiority of Macadamized Roads for Streets of large Towns," by Mr. J. P. Smith.—There is a prevalent feeling against the employment of broken stone roads for streets, because, as they are usually managed, they are the cause of great inconvenience to householders and others by the dirt and dust they occasion, and also because their maintenance and repairs are very expensive, while the draught of vehicles upon them is very heavy. The object of this paper is to prove, from long-continued experience on a large scale, that those objections do not necessarily accompany the use of such roads. In discussing this question, the interests of two parties must be considered: those who principally use the road, the owners and employers of horses and vehicles,—and those who pay for it, the rate-payers, who are they who would be injured and annoyed if it were unduly expensive or unnecessarily dirty, dusty, and noisy. It is a common error to consider that road the cheapest which costs the least in direct expenditure. If, however, this so-called cheapest road causes waste of horse-power, undue wear and tear of horses and vehicles, loss of time by being unfit for rapid transit, and occasions loss to the inhabitants by filling their dwellings with dust, and covering their clothes with dirt, it is evident that such a road is really very dear. There is an apparent diversity of interest between those who use and those who pay for our public streets;

as the principal loss from bad roads falls directly upon those who keep or employ horses and vehicles, while the expense of road repairs falls upon the inhabitants generally. A little consideration, however, will show that this diversity of interest is more apparent than real. It is the interest of all that there should be easy, safe, and cheap means of transit through the public streets; and any increase in the cost of transit is a source of indirect expense, even to those who have no horses of their own, as it must add to the cost of everything carried through the streets, and of all hired vehicles, and of all the numberless conveniences which accompany residence in a large town. It must also be remembered, that it is very wasteful to allow a road to go out of repair, since it is less costly to keep a road up than to restore it. That roadway is best for the owner or user of a horse or vehicle which can be travelled over most easily, safely, quickly, and cheaply; and that ease, safety, speed, and economy are to be obtained by having the road firm, even, and smooth, and perfectly free from mud or dust, or any form of unattached materials. It is evident that the same qualities will render the roadway most free from noise, dirt, and dust, the three great causes of annoyance and injury to the inhabitants of all ordinary streets. The question which remains to be considered is, whether the advantages of good roads to the inhabitants generally are worth their cost? If the question had to be decided in accordance with the interest of the users and owners of horses merely, no doubt whatever would be entertained. Of whatever nature the surface of a road is to be, it is essential that its foundation should be of firm material, well consolidated, and perfectly drained; if not, the crust becomes loosened and destroyed, the road is rough and uneven, and wears into holes and ruts. Having obtained a good foundation, the next point is to cover it with a hard, compact crust, impervious to water, and laid to a proper cross section. The stones must be broken to one regular size, well raked in, and fixed there by a binding composed of the grit collected in wet weather by the sweeping-machines, and preserved for this purpose. This binding must be laid on regularly, and watered until the new material is firmly set, which it will do very quickly, and with the regularity of a well-laid pavement. The sharp angles of the stones are preserved, and there is both great saving of material, and a firmer crust formed, than by the common method of leaving the material to work into its place without the use of binding,—in which case the angles of the stones are worn off and reduced to powder, and at least one-third of the material is wasted in forming a binding in which the stones may set. By the improved method, the binding is formed of material that would otherwise be useless. Many road-makers object to the use of binding, on the ground that the road is rendered rotten by it, and that when the road is set it has to be carted away again. This is apt to be the case under bad management; and when ordinary soil is used, the fine particles of which work it into mud, and keep the road from setting firmly. But the coarse grit obtained by the sweeping-machine off the roads is the very same material as is produced by wearing away the angles of the stones, and when judiciously applied to a new coating it will speedily become as well consolidated and firm as an old road. In the common method, not only is there great waste of material, but the loose stones occasion delay by their resistance, great fatigue to the horses and danger to their feet, while the noise produced by their grinding together is annoying to the inhabitants. Upon the improved method, the inconveniences of road repair are incomparably less than those of pavement. Both recoating and repairs may be made without stopping the traffic. Under no circumstances must any imperfection of surface be allowed. If a hollow be not immediately stopped, it very quickly extends over the surface. All loose stones should be carefully picked, as every loose stone passed over by heavily laden carriages, if not ground to powder, breaks the crust of the road; and if water be permitted to lodge on the surface, it will cause great mischief. It is the neglect of these essential precautions that has led many to consider macadamized roads expensive. They *are* expensive if neglected. On a well-made road heavy showers do good, by cleansing them; so also does artificial watering, if the road be clean, or swept quickly after it is watered. A road which is perfectly dry loses its tenacity, and the surface grinds into dust; whence the economy of judicious watering in hot weather, which preserves the road, as well as prevents the annoyance of dust. The practice so common in London and elsewhere of heavy watering a dirty road without cleansing it, and thereby converting the dust into mud, is very injurious to the road, and merely changes one nuisance into another—dust into mud. A great source of waste, both to those who use and to those who repair a road, is to allow it to be dirty. The draught on a dirty road is twice as heavy as on a clean one—that is, a horse must exert double force to draw his load with the same speed. The cost, however, of employing double force is so great, that the expedient of diminishing the speed is generally adopted, as a horse can exert greater pulling force at a slower pace—less power being required to carry his own body. It often happens that the extra resistance occasioned by dirt diminishes the speed one-fifth, or one-fourth. The effect of the dirt, therefore, is to increase the work by twenty or twenty-five per cent. It will easily be believed that such a waste far exceeds the cost of the most perfect cleansing. This is the case when cleansing is done by scrapers, the greatest enemy a macadamized road has to contend against. By their use the stones are dragged from their places, and the adhesive dirt is not effectually taken away. Sweeping is the only mode of cleansing that should be allowed, either on streets or on turnpike roads. Sweeping by the wide brooms of Mr. Whitworth's machine is preferable to all other modes of cleansing yet tried. It must be evident, that the fact of these wide brooms sweeping longitudinally, with a pressure that can be adjusted according to circumstances, tends powerfully to preserve the road, and to consolidate its surface. They press most upon the ridges, and least upon the hollows, thus tending to reduce the former, and fill up the latter. When the dirt is stiff, and adheres firmly to the stones, it should first be well watered, when it may be completely removed by the machine, without disturbing the crust, leaving the surface firm and compact. The use of water for this purpose has been objected to by high authorities, on the ground that it *does* remove the useful grit; but the contrary has been proved by ample experience. I have found that the use of the sweeping-machines, with the proper employment of water, has reduced the amount of material required for the repair of roads in Birmingham one-third—namely, from about 20,000 to 13,000 cubic yards. The first-named amount is the average for seven years preceding the introduction of the machines,—the latter of the three years subsequent. I communicated these details to a friend in London, and he determined to test their correctness. The following is the result of his experiment, to settle whether useful grit was or was not removed by water and machine sweeping. On the 22d of March last, the Quadrant, Regent Street, was covered with a thick layer of dirt, which was causing great annoyance as well as injury to the road, but could not be removed by scraping, without removing also much of the new stone, to which it adhered. It was determined to sweep half of it dry, and half after proper watering. This was done, and the sweepings removed were washed, to separate the refuse from the stony matter mingled with it. One-third part of that which was taken dry, consisted of coarse grit, which would have been useful on the road—one-twelfth part only of that which was removed in the form of slop was stony matter; and that was so completely pulverized, as to be of scarcely any use,—it had done its work. After the two portions of the road had been cleansed, the difference between them was very striking. That which was swept dry was still covered with adhesive matter, which was lifted by the wheels, together with the stones to which it adhered, the whole road being rough and uneven; the portion which had been swept with water was perfectly even and smooth. On the 24th both portions were swept, but only one quarter as much dirt was taken from that which had been water-swept as from the other. On the 26th it rained, and three times as much slop was taken off the part of the road which had not been water-swept on the 22d. The preservative effect of water machine sweeping was most evident, by the decidedly better condition of that portion of the road cleansed in this effective manner. The great objection urged against macadamized roads for streets is the annoyance by dust and dirt which they occasion, and many persons prefer submitting to the deafening noise of pavement in order to avoid these; but this would not be the case if water and machine cleansing was adopted, the cost of which would be saved in diminished wear and tear. The entire cost of cleansing and watering Birmingham is about £5,000 per annum,—or less than one penny per week for each of its inhabitants. It has been objected to macadamized roads, that the draught upon them is heavier than upon pavement; and with carriages altogether similar this is the case, and especially so with vehicles travelling slowly. But it must be remembered, that the proportion of the draught is only one of the circumstances by which the labour of the horse is to be estimated. Another very important consideration is the surface which gives the horse the safest footing; and his footing on pavement is so much less secure than upon a good broken stone road, that he does not receive the full advantage of the smaller draught. Again, carriages—especially those travelling quickly—are exposed to much more violent concussions upon pavement than upon a smooth macadamized road,—consequently, not only must the carriages be stronger and therefore heavier, but the increased frequency and violence of the concussions consume a larger portion of power, which goes far to counterbalance the diminished friction. There can be no doubt that the wear and tear of both horses and vehicles is far greater upon pavement than upon macadamized roads. In reckoning the real cost of a road, all expenses attending its use should be calculated; and if this were done, pavement would be perceived to be exceedingly expensive. Carriages roll so smoothly over a well-maintained macadamized road, and horses are so little injured either by falls or strains, that I conceive the wear and tear upon them is not half of what it is on pavement.

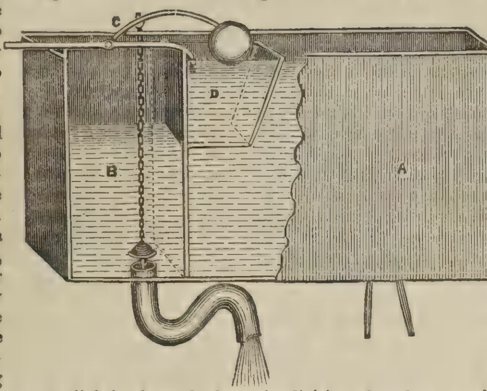
"On Hosmer's Self-discharging Cistern as a Sanatory Machine," by M. W. Wood.—A model of this apparatus was exhibited, the intention being to discharge, by a self-acting valve, a periodical flow through the drains of the house, which, combining with a similar simultaneous discharge from the neighbouring houses, would sweep the sewers clear every three or four days, as might be desired.

Fig. 1.



The cistern intended for an intermittent water supply, is represented in fig. 1, which is an elevation of the apparatus, with a portion of the front side of the vessel broken away. It is divided into two parts, the one marked B, being for cleansing the drains, whilst the other and larger one is for the domestic supply. The ball and lever works a two-way inlet-cock, one aperture being in connection with each section of the vessel. When water from the main is supplied, the division B being filled first, the water flows over into the second one, and the rise of the level in it elevates the ball and lever, until stopped by the pressure of the fluid column upon the valve at the bottom of division B, which is connected to the lever by a chain. As the water continues to rise, the ball becomes nearly immersed, when its superior buoyancy, overcoming the pressure upon the valve, suddenly lifts it high enough to allow the water to flow freely through the syphon-trapped pipe below into the drain. The water in the larger division, as it fills, is retained for domestic use.

Fig. 2 is a corresponding view of a similar arrangement suited for a constant water supply. Here there are also two divisions, the larger one being devoted to domestic purposes. The inlet-cock, worked by a ball and lever, opens into the separate chamber, D, in which the ball-float works. This chamber has a piece of porous stone, or a drip-cock near its bottom, to allow water to percolate from it into the smaller division employed for cleansing the sewers, and its top is slightly elevated above the division-piece between the two main sections. The water flows into the large division first, and then, as it rises, it pours into the chamber, D, and continuing to rise as before, the greater buoyancy of the float overcomes the pressure on the bottom valve, and permits a forcible rush of water into the drain. The contents of the large division remain for use, and a further supply is cut off by the ball-cock. The water in the little chamber, D, now percolates, drop by drop, through the porous diaphragm into the smaller division, and thus the float is lowered, and the large valve at the bottom is again placed on its seat; the inlet-cock again opens, and the operation is repeated. The periods of discharge are governable by the capacity of the percolating medium—to flush once a day, or otherwise, as may be needed.



Mr. Hosmer has also introduced two other contrivances,—one is a roof cistern, to discharge storm and rain water; and the other is a self-discharging street tank, for either an intermittent or constant supply.

MONTHLY NOTES.

Philosophical Information in Bury.—The inhabitants of Bury, Lancashire, have recently been entertained with an extraordinary discussion upon the question as to the true contour of the earth. We had thought that Newton would have afforded the good folks of Bury sufficient satisfaction on this point; but we have miscalculated their aptitude for learning. The subject was thus put, "The earth not a globe, but a plane;" but however plain a point it may appear, the Bury philosophers have not yet made up their minds which way they will have it. A wonderful deep-thinker, who styles himself "Parallax," took the affirmative of the proposition; and Mr. Chattwood, an architect, the negative. Two evenings were devoted to the matter, "Parallax" being the favourite on the first occasion, and the architect claiming an advantage on the second. Whatever ridicule may attach to this inane sport, we have to note that the Mechanics' Institution has been a gainer by it to the extent of £2. 2s. 11d., one-half of the admission proceeds being paid to "Parallax" and the Institution respectively.

Chinese Iron.—A very interesting importation from the Chinese empire has just been made in the shape of a cargo of 2,990 tons of iron, in pigs. This large consignment formed part of the freight of the *Mencius*, recently arrived in Liverpool from Hong-Kong.

London Exposition of French Manufactures.—The visitor to the Birmingham Exposition has probably remarked, in close neighbourhood with the section devoted to papier-maché articles, a collection of bronzes and general ornamental works of more than ordinary merit, which, if his curiosity had prompted him so far, he would discover to be of French origin. M. Sallandrouze de Lamornaix, ex-depute and member of the Acting Council of Manufactures at Paris, and one of the most eminent of French manufacturers, is the exhibitor of this mass of elegance, which appears as an offshoot of a larger collection now displayed in George Street, Hanover Square, London. This miniature Exposition is composed of a selection of some of the best articles in the last Parisian gathering; and to M. Sallandrouze de Lamornaix its management has been intrusted by the leading producers of his country. Seven rooms, in addition to galleries, staircases, and corridors, are here crowded with choice specimens of French art, bronzes, metal and cabinet works; Sevres porcelain, emblazoned with all the taste and magnificence which have ever combined to adorn this manufacture; modern illuminated works, and rich book-bindings, with which the best productions of monkish times are not for an instant to be compared; Gobelins tapestry; carpets from Ambusson; silks and velvets from Lyons; gorgeous paper-hangings; intensely delicate lace and Cashmere shawls; and lastly, jewellery of the highest finish,—are all congregated in profusion, forcibly exhibiting how much the industry of the country where they have originated is devoted to the mere adornments and embellishments of life. France is the very aristocrat of manufacturing localities; and her extreme anti-utilitarian spirit is graphically enough set forth under the auspices of M. Sallandrouze de Lamornaix. In the first room are placed the bronzes, including one of Shakspeare, by M. Emile Thomas; and a collection of jewellery; but the gems of the apartment are a missal, executed for the Queen of Spain, and lent by her for exhibition; and a book-binding, exquisitely carved in lime-tree. Cabinet work and ornamental furniture, the productions of M.M. Tahau and Laurent, fill the second room; and the staircase leading from it is decorated with paper-hangings by M.M. Madire and Genoux. The immense Aubusson carpets and tapestry from the Gobelins furnish out the third apartment, in connection with bronzes, Roman Catholic altar ornaments, pianos, and Sevres porcelain. The principal carpet designs are flowers and fruit, the richness and fine softness of texture of which are perhaps unrivalled. In the set-out of porcelain, the most striking objects are three great vases—the largest, of a tazza form, is a combination of bronze and porcelain, the body being a brilliant blue, with flowers, painted by Jacobs. In the fourth room is a display of ornamental mouldings in laminated zinc, by the "Societé des Zincs de la Vieille Montagne," which carry credentials in the shape of a large gold medal, won at the Paris Exposition. The examples exhibit the fitness of these mouldings as a substitute for wood-carving, the stone capitals of pillars, and the sheathing of ships. M. Schlumberger's wool-carding machine here represents the mechanical productions of Mulhouse; its turn-out is said to be from 50 to 60 lbs. per day. In the fifth room, surrounded by a columnar gallery, is a fine collection of optical instruments, by M. Lerebours, of Paris, so well known for his daguerreotype and object-glasses. The rest of the exhibition is made up of the endless elegancies of France, some of the best of which are by the exhibitor himself. Whilst there is in the Exposition much that is admirable, we may add, for the consolation of our own manufacturers, that there is also much that is to be described by a very opposite term. How much, and what is the inferiority, we need not state; it is enough to point out what is good, and worth the attempt to rival.

Government and the Royal Society.—We have been agreeably surprised by the appearance of the official statement in reference to the assistance proposed to be rendered to the Royal Society, through Lord John Russell, to the extent of £1,000 per annum. Whilst we record the fact with some pleasure, it is not unmixed with the disagreeable feeling arising from a knowledge of the long neglect which science has suffered at the hands of those who ought to be its best and kindest fosterers. The supply is to be continued in succeeding years; let us hope it will be augmented, and that this is but an earnest of a better feeling between men of science and men of money.

Leon's French Tracing Paper.—We have by us a specimen of this tracing paper, forwarded for our inspection by Messrs. Waterlow of London Wall. As we have frequent inquiries on the subject of the manufacture of this article, we may at once make reference to Leon's, as being equal to all requirements. The sheet we have tried possesses all the beautiful clearness and firm resisting power for the pen, for which the French manufacturers have always been celebrated. From its peculiar mode of preparation, the finest lines may be drawn upon it, without incurring the risk of uncertainty or feebleness on the one hand, or an objectionable running on the other. It is made in pieces 40 inches wide, by 21½ yards long, at a selling price of 20s. per piece, or in quires, 30 by 40 in. at 11s. As we are so often asked for receipts for the manufacture of the paper, we may give a general answer to all such queries by stating, that no application of any transparent medium to the common thin paper usually employed for this end, can produce anything at all to be compared to Leon's manufacture.

Death of Sir I. K. Brunel.—We have this month to record the death of this, in many respects, extraordinary man, best known by his great work, the Thames Tunnel. The *Times* has a short memoir of him, which we reprint as being a concise history of his origin and career:—"Sir Isambert Brunel was by birth a Frenchman; but his life and genius were almost wholly devoted to the invention and construction of works of great public utility in this country. He was born at Hacqueville, in Normandy, now in the Department de l'Eure, in the year 1769. He was educated for the church, with the prospect of succeeding to a living, and was accordingly sent at an early age to the seminary of St. Nicain, at Rouen. But he soon evinced so strong a predilection for the physical sciences, and so great a genius for mathematics, that the superiors of the establishment recommended he should be educated for some other profession. Accordingly, at the proper age, he entered the royal navy, made several voyages to the West Indies, and returned home in 1792. At this time the French Revolution was at its height, and as Mr. Brunel entertained royalist opinions, he emigrated to the United States, where necessity, fortunately, compelled him to follow the natural bent of his mind, and to adopt the profession of a civil engineer. He was first engaged to survey a large tract of land near Lake Erie. He was employed in building the Bowery Theatre in New York, which not many years ago was burnt down. He furnished plans for canals, and for various machines connected with a cannon foundry then being established in the state of New York. About the year 1799, he had matured his plans for making ship blocks by machinery. The United States was not then the field for so inventive a genius as Brunel's. He determined upon visiting England, and offering his services and plans for this purpose to the British government. Lord Spencer, then, we believe, First Lord of the Admiralty, became his friend and patron. From this time he continued to reside in England, and refused to entertain many propositions made to him to leave this country and settle abroad under the auspices of other governments. After much opposition to his plans, he was employed to execute them in Plymouth dockyard. To perfect his design, and to erect the machinery was the arduous labour of many years. With a true discrimination, he selected Mr. Henry Maudslay to assist in the execution of the work; and thus was laid the foundation of one of the most extensive engineering establishments in the kingdom, and in which, perhaps, a degree of science and skill has been combined and applied to mechanical invention and improvement scarcely exceeded by any other in the world. The block machinery was finished in 1806; and has continued ever since in full operation, supplying our fleet with blocks of very superior description to those previously in use, and at a large annual saving to the public. A few years afterwards he was employed by government to erect sawmills, upon a new principle, in the dockyards of Chatham and Woolwich. Several other inventions were the offspring of his singularly fertile mind about this time: the circular saw for cutting veneers of valuable woods, and the beautiful little machine for winding cotton thread into balls, which greatly extended its consumption. About two years before the termination of the war, Mr. Brunel, under the countenance of the Duke of York, invented a machine for making shoes for the army by machinery, the value and cheapness of which were fully appreciated, and it was extensively used; but the peace of 1815 lessening the demand, the machinery was ultimately laid aside. Steam navigation, also, at that time attracted his attention. He was engaged in building one of the first Ramsgate steam-boats, and, we believe, introduced the principle of the double engine for the purpose. He also induced the Admiralty to allow him to build a vessel to try the experiment of towing ships out to sea, the possibility of which was then denied. The visit of the Emperor Alexander to this country after the peace, led him to submit to the emperor a plan for making a tunnel under the Neva, where the accumulation of ice, and the suddenness with which it breaks up on the termination of winter, rendered the erection of a bridge a work of great difficulty. This was the origin of his plan for a tunnel under the Thames, which had been twice before attempted without success."

American Steam-Boat Novelties.—Amongst the latest of the mass of novelties which America is constantly bringing out, is an iron steam-boat, the "John Neilson," built by Messrs. Stevens, to run between New York and New Brunswick. The peculiar feature in this boat was the forcing through the bottom a series of jets of air, at a pressure of three or four pounds per square inch; the intention of her designers being to diminish the draught of water, and, consequently, the moving friction. The length of the boat was 180 feet, breadth 28 feet, depth of hold 8½ feet; having a single engine, with a 56-inch cylinder, with a 12-feet stroke, cutting off at 6½ feet. Paddle-wheels, 32 feet diameter, and 10 feet wide; depth of paddles, 28 inches; revolutions per minute, 20. She had two tubular boilers, 14 ft. 6 in. long, 10 ft. 7 in. wide, and 8 ft. high; with two furnaces to each, 7 ft. long, and 4 ft. 7 in. wide, and in each furnace was one lower flue, running to the back of the boiler, and 180 2-inch tubes above, making 360 tubes of 10 feet in length in each boiler. Two small engines, with 12-inch cylinders, and 12-inch stroke, were arranged to give motion to a pair of blowers for the furnaces, running at 300 revolutions, the engines themselves making 50. The air driven out at the bottom of the boat is forced by two blowing cylinders, 40 inches diameter, and 4-feet stroke, making 60 strokes per minute; each cylinder being worked by a steam-engine, with a cylinder 16 in. diameter, and 4-feet stroke, cutting off at one-half. All these subsidiary engines exhaust their steam into the condenser of the large engine. If we wished to depict the midship section of this curious craft, we should draw a rectangular open-topped chest, her bottom being perfectly flat, with square bilges. The air was forced out in 75 jets, varying in size from 1 in. to 4 in. diameter, each having a guard at its mouth to direct the air-current aft, and 4 projections or keels, 3 inches deep, were formed along the bottom, to guide the air-current along the whole length of the hull, to escape at the stern. In their stretch after extraordinary results, the engineers forgot a good many things which are well known, and ought to be remembered by all who endeavour to compass vast improvements in so difficult a science as that of marine propulsion. We have furnished some idea of the midship contour, let us add to it a fine thin bow, with a run to the stern like that of a coal barge, and we have somewhat of a notion of the whole architectural system of a boat, be it remembered, built to get 30 miles an hour. Need we add, that it didn't do anything like this? With the whole apparatus of blowers in operation, she made 15 miles; the amount of gain by the adoption of the bottom blast being, that the large or propelling engine makes 1½ revolutions more with the blast than without it. But boats of ordinary build and similar power get at least three miles an hour more; hence we require little aid from arithmetic to show a loss in Messrs. Stevens' hands. We do not mean to throw cold water upon the bottom-blast system, which, on the contrary, we look upon as a most ingenious notion. But one novelty at once is quite enough in a steamer. Had her engineers been content to get an air-blast in a simpler way, and to have applied the thing to a tested model of tolerable proportions, better results might have been got. But, in recapitulating the details of the machinery, we are rather confused amongst so many distinct steam-engines. We find, first, a goodly steam-propelling engine, then a pair of furnace-blowing engines, and lastly, another pair, and of large size, for the bottom air-blast. In fact, it is stated that 100 feet of the hold is occupied by the machinery; an additional complement of persons are required for its attendance; and the noise is abominable. However, the fact of the gain by the air-blast has been developed; it may do better with better usage.

Liverpool Contribution to the Exposition of 1851.—Mr. Grantham, C.E., of Liverpool, has originated, and the municipal authorities now talk seriously of carrying out, the idea of executing a model of the docks and warehouses of the town, as a contribution to the approaching Exposition. It is intended to be on the scale of eight feet to a mile, and to show the whole of the docks and warehouses along the frontage of the river. In this proportion the model will be 32 feet long. Such a production will certainly be both curious and useful; curious—as it will enable the visitor more nearly to comprehend the commercial vastness of this wondrous monument of merchandise; and useful—as it will be a speaking map for the guidance of foreigners in assuring themselves of the locality, capability, and general fitness of the shipping accommodation.

Application of Electro-Magnetism to give Adhesion to Railway Wheels.—Mr. Hjorth's improved electro-magnetic mechanism, and Mr. H. Smith's solid wrought-iron wheels, both of which have received a notice in our earlier pages, are likely to be made jointly applicable for a useful purpose not originally intended. We have long had an idea that magnetism might possibly be employed to obtain a tractive adhesion without the use of the heavy modern locomotive, and the two inventions referred to seem to point towards its practicability. The same thing is obviously applicable as a retarding power.

The American Steam Navy.—Within the last twenty years, the navies of England and France have undergone a great change by the introduction of steamers, and in any naval contest this country, at the onset, would suffer from the want of a suitable number of vessels of that class. By the liberal aid which the English government have extended to private companies, they have in reserve a very large number of first-class steamers at a nominal expense. Our own government are now trying, in a measure, to make up for lost time, and contracts have been made with parties who are to build the following steamers for the routes designated, with the understanding that, in case of war, the Navy Department may take the vessels at a valuation.

4 of 2700 tons,	to run from	New York to Liverpool.
4 of 2400 ...	...	New York to New Orleans.
3 of 800 ...	...	Panama to Oregon.
3 of 1800 ...	...	New York to Bremen.

Of these vessels there are two of the New Orleans line finished, three of the Pacific, and two of the Bremen line; the rest are in a state of forwardness, and will probably be all done in twelve months. In addition to the above, there are 13 sea steamers, from 500 to 1000 tons burthen, employed in private service between New York and New Orleans, at the different ports, making an aggregate of 40,000 tons, which could be at the disposal of the government when required, although several of the vessels have no mail contract. Having spoken of the private steamers, those that the government *may have*, I propose to go on and speak of those vessels which really belong to the navy, most of which have been built from the designs furnished by the proper departments, and may, therefore, be considered indicative of the ideas entertained at the Navy Department in relation to war steamers. This, of course, applies to those now building, and not to those already built, of which I shall speak first. The first of the naval steamers we now have is the "Fulton," built about twelve years since. It is much to the credit of the department, that no person has been willing to assume the responsibility of having designed this vessel; like Japhet, she has long been in search of a father, but without any prospect of success. She is now at anchor at the Brooklyn Navy Yard, being of no service, except to be used in the harbour of New York. The department would do well to remove the machinery, which is very good, and, with some changes, would answer for a ship of 1000 tons. As she now is, she would not be safe out of harbour, and cannot be considered as of any account when speaking of *sea steamers*. Our second vessel is the "Mississippi," a fine steamer, built in 1841, about 220 ft. long, 40 feet beam, 23 feet hold, with 2 English marine side-lever engines, of 460 horse power, and 4 copper boilers for bituminous coal. This vessel has been in commission about eight years, during much of which time she has been in active service, and has always given satisfaction. She has recently made the passage from Norfolk to Gibraltar in 16 days, with an average consumption of 30 tons of coal in 24 hours. The "Missouri," a sister ship, but with inclined engines, was burnt a few years since at Gibraltar. Our third vessel is the "Princeton," a propeller. This ship is about 160 feet long, 30 feet beam, and 20 feet hold; has two semi-cylinder engines, and a propeller of 14 feet diameter; 3 boilers of iron, and uses a fan to increase the draft, natural draft not being sufficient to supply the required head of steam. This vessel may be considered the best of her class, and has done considerable service. She has just returned from a two years' cruise in the Mediterranean, and her hull has been condemned. She was built in 1843, of white oak obtained in a hurry, and her rapid decay is, in a great measure, no doubt, owing to the great heat of the boilers. Our fourth vessel is the "Allegheny," built of iron at Pittsburg two years since. She is about 180 feet long, 32 feet beam, and 19 feet hold. She is propelled by two of Hunter's submerged wheels, of 14 feet diameter, and 4 feet face, with engines of 60 inches diameter of cylinders, and 4 feet stroke; usual number of revolutions, 30; 2 boilers for bituminous coal, with natural draft. The model of this ship is peculiar to this mode of propelling, being cut away under the water line, so as to allow the paddles to project. This vessel has been in service about two years, most of the time at Brazil and the Mediterranean, from whence she recently returned. Her speed at sea is not more than 6 miles per hour, and she is probably the last of her class, as this mode of propelling has nothing to recommend it to favour. Our next vessels are the "Massachusetts" and "Edith," propellers, both now in the Pacific. These vessels were bought for private service during the Mexican war, and were transferred to the Navy Department at its close. They are about 500 and 700 tons, with a speed of from 6 to 7 miles per hour, and would most likely be used as transports. The "Water Witch" comes next, a small iron steamer, with side wheels. She was originally built with Hunter's wheel, but condemned, then lengthened, and Loper's propeller put in. She then made the passage from Philadelphia to Norfolk, was then again condemned, and a condensing engine and side wheels put in. She is now considered a fair vessel of about 250 tons. The last we have is the "Vixen," a small vessel, 118 feet long, 22 feet beam, and 8 feet hold, originally built for the Mexican government; engine with 36 inch cylinder, 6 feet stroke; speed, 8 miles per hour. This, and the "Spitfire," a sister vessel, were constantly employed, during the Mexican war, on the coast of Mexico, where their light draft of water rendered them invaluable. These are all the vessels at present belonging to the navy that are finished, and can be brought into use on our seaboard. I will continue the subject, and speak of the steamers now building, in your next.—*Franklin Journal.*

Miller's Improvement on Morton's Slip.—Morton's slip is favourably known as a most efficient apparatus for the purpose of docking vessels for examination or repairs, and its merits have led to its very general adoption in the large ports of this country, as well as in many of those of our foreign relations. Our reason for now drawing attention to it, is to make known a very valuable improvement recently made upon it by Mr. Daniel Miller of this city, and which adds considerably to its efficiency. In place of the ordinary wheel gearing employed for working the slip, Mr. Miller has very cleverly substituted a hydrostatic purchase. A long hydrostatic cylinder is secured horizontally to a firm foundation of its own, at the head of the slip, with its open end pointing up the incline. A cross-head on the end of the ram carries two side-rods, passing backwards, one on each side the cylinder, to a second cross-head below, or rather behind, the closed end of the cylinder, as a connection for the traction-rods attached to the hauling carriage for conveying the vessel. On the upper side of the hydrostatic cylinder, and near its open end, is a bracket, carrying a small horizontal steam cylinder, the connecting-rod of which drives a crank-shaft set in bearings on a pair of pillars midway in the length of the cylinder. A corresponding bracket on the opposite end of the hydrostatic cylinder, carries one or more horizontal pumps, employed as the actuating medium for the large cylinder, as in the ordinary Bramah press; and from these pumps a curved water-pipe passes into the cylinder at its closed end. When a vessel is to be taken up, the carriage is run down the incline to receive it, and the lowest traction-rod of the purchase-chain is then attached to the keel-beam of the carriage, the ram of the hydrostatic cylinder being at the commencement of its stroke. The ram is then steadily forced up out of the cylinder by the action of the steam cylinder on the pumps, carrying up the carriage and vessel; and on the completion of the stroke, the traction-rod nearest the cylinder is removed, and, at the same time, the traction apparatus itself shuts a valve between the pumps and the cylinder, whilst it opens another for the discharge of the water which has just performed the stroke. A roller or barrel on the steam-engine crank-shaft is then put in gear, and winds up a chain attached to the cross-head of the ram, which is thus forced again into its cylinder, ready for a new stroke. The second traction-rod of the purchase-chain is then attached to the cross-head, whilst the self-acting apparatus is reversing the valves of the water-way, and putting the winding roller out of gear. The same action is then repeated, until, by a succession of movements, the vessel is carried up the slip to the necessary height. The arrangement of the machinery is very neat, and it may, of course, be actuated by animal labour instead of a steam-engine, if required. Mr. Miller sums up the advantages of his plan, fairly enough, as follows:—1st. The improved machinery may be laid down for less than one-half the cost of the present apparatus; for very large ships, much less. 2d. Ships will be taken up at double the speed, as but a very small proportion of the power is absorbed by friction; and from the automatic nature of the machinery, no time is lost by stoppages to take fresh hold. 3d The motion, in drawing up a ship, is so perfectly smooth and uniform, that no part of the carriage or ship is exposed to any undue strain. And, 4th. It occupies little space; is not subject to breakage; and the same foundation answers for both purchase-machinery and steam-engine.

The Mahratta Potentate and English Inventions.—To solve his doubts as to the alleged perfection of many of the more extraordinary mechanical productions of late years, a Mahratta king, the Guicowar, has issued orders for the supply of a set of working models of railways, locomotives, and electric telegraphs. These models are now being made in this country, and will probably satisfy the curiosity of the great man, which books and drawings have only served to arouse.

Design as applied to Calico Printing.—Mr. George Wallis, formerly head-master of the Manchester School of Design, has just delivered the first of a course of three lectures at the School of Design, Somerset House, under the auspices of the Board of Trade. The aim of the lecturer was to give practical details in reference to the conditions of design as applied to calico printing. He pointed out the technical conditions of design as involved in the several varieties in the modes of production, explaining the nature of mordants, resists, and discharges, and their bearing on the artistic effect obtained in printing, as regards colour, light, and shade—form being explained to be dependent rather upon the mechanical than the chemical conditions of production. The subject also led him to the enumeration of the several methods of block printing, machine or cylinder printing, and the metal-type system just used for calicoes, and now adapted for carpets. The leading difference in the results of steam and madder printing, as instanced, in the steam class, by mousseline de laines, and, in the madder section, by "Hoyle's prints," was lucidly pointed out. He also gave some useful information on the various methods of engraving the pattern on copper cylinders, and the peculiar points in which these methods guided the proceedings of the designer. In connection with this part of the lecture, a model of a cylinder, with a "mill," as produced from the manually-engraved die, was exhibited in elucidation of the system of engraving technically known as "milling." It was shown that the conditions of design were not so limited as might perhaps be inferred, and that, in fact, range of colour is one of the main limitations in the ordinary classes of printed goods; in the special case of "milling," smallness of repeat being essential. In furnitures, cost alone limits the design, as nearly every effect of light, shadow, and colour may be produced in this department. As a suggestion of his own, Mr. Wallis mentioned that the historic styles of ornament could hardly be more legitimately employed than in furniture decorations. He urged upon the students that they were not to consider these conditions as fetters upon their artistic powers—quoting the well-known remark of Sir Joshua Reynolds, first given to the world in the very room where they were now assembled, that "rules were not fetters to men of genius, but fetters only to men of no genius." In his position as master of the Manchester School, Mr. Wallis showed himself to be amongst the very few practical and yet artistical teachers which our schools of design possess. It might have been well for the Manchester district had it been possible for him to have continued to them his valuable aid. As it is, we are glad to see that he still labours with right goodwill in his legitimate field of artist-manufactures. The remaining two lectures, yet to be given, are to be "On design as applied to silk-weaving by the jacquard loom," and "On embroidery by hand and by machinery." For the task involved in the elucidation of these subjects, we should suppose Mr. Wallis' practice in the celebrated works of Schwale will have eminently qualified him.

ENGLISH PATENTS.

Sealed from 17th November, 1849, to 12th December, 1849.

John Webster Hancock, Melbourne, Derby, manufacturer,—"Improvements in the manufacture of hosiery goods, or articles composed of knitted fabrics."—November 17th.

Charles Edouard François Constant Prospere De Changy, Brussels, now residing in Tavistock-street, Westminster, civil engineer,—"Improvements in the preparation and manufacture of flax, hemp, and other like fibrous substances."—20th.

Charles Cowper, Southampton-buildings, Chancery-lane,—"Certain improvements in the manufacture of sugar."—(Being a communication.)—20th.

Francis Justin Duburguet, Cahors, France,—"Certain improvements in hydro-pneumatic engines."—22d.

Joseph Pierre Gillard, gentleman, Paris, France,—"Certain improvements in the production of heat, and light in general."—22d.

William Garnett Taylor, Burton House-hall, Westmoreland, gentleman,—"Improvements in lint and linting machines."—24th.

George Calloway, Putney, Surrey, station agent, and Robert Alleé Purkis, same place, engineer,—"Certain improvements in propelling ships and other vessels, also in apparatus for ploughing land."—24th.

Charles Cowper, Southampton-buildings, Chancery-lane,—"Certain improvements in piling, fagoting, and forging iron for plates, bars, shafts, axles, tyres, cannons, anchors, and other similar purposes."—24th.

Joseph Barrow, St. Paul's, Deptford, Kent, engineer,—"Improvements in axles and axle-boxes of locomotive engines and other railway carriages."—24th.

Ambroise Ador, Paris, France, engineer,—"Improvements in producing light."—24th.

Henry Lamplough, Snow-hill, consulting chemist,—"New mode of supplying pure water to cities and towns."—24th.

Frank Clarke Hills, Deptford, Kent, manufacturing chemist,—"An improved mode of compressing peat for making fuel or gas, and of manufacturing gas, and of obtaining certain substances applicable to purifying the same."—24th.

Francis Tongue Rufford, Prescot-house, Worcester, fire-brick manufacturer, Isaac Marson, Cradley, same county, potter, and John Finch, Pickard-street, City-road, Middlesex, manufacturer,—"Improvements in the manufacture of baths and wash-tubs, or wash-vessels."—24th.

James George Newey, and James Newman, Birmingham,—"Improvements in the manufacture of button studs, and other dress fastenings and ornaments."—28th.

Charles Barlow, Chancery-lane, London,—"Improvements in the manufacture of a certain pigment."—(Being a communication.)—29th.

Louis Napoleon Le Gras, Paris, France, civil engineer,—"Improvements in the separation and disinfection of fecal matters in the manufacture of manure, and in the apparatus employed therein."—30th.

Walter Crum, Thornliebank, Renfrew, Scotland,—"Certain improvements in the finishing of woven fabrics."—December 3d.

Conrad Montgomery, Army and Navy Club, St. James's-square, Middlesex, Esq.,—"Improvements in brewing, distilling, and rectifying."—3d.

William Eccles the elder, William Eccles the younger, and Henry Eccles, Blackburn, Lancashire, cotton-spinners,—"Certain improvements in machinery or apparatus for preparing, spinning, and weaving cotton and other fibrous substances."—3d.

Joseph Paradis, Lyons, France, merchant,—"Improvements in the manufacture of elastic mattresses, cushions, and paddings, part of which improvements are applicable to other purposes, where sudden or continuous pressure is required to be sustained or transmitted."—(Being a communication.)—3d.

George Buchanan, Edinburgh, civil engineer,—"Improvements in cocks, valves, or stoppers, and in the use of flexible substances for regulating or stopping the passage of fluids, and also in making joints of tubes and pipes, or other vessels."—3d.

Baron James Ulric Vancher de Strubing, of Margaret-street, Cavendish-square, Middlesex,—"Improvements in the manufacture of axletree boxes for carriages, and of the bearings of the axles of railways, and in the making of an alloy of metal suitable for such and like purposes."—3d.

George Edmond Donisthorpe, Leeds, York, manufacturer,—"Improvements in wheels of locomotive carriages."—3d.

Peter Fairbairn, Leeds, York, machinist, and John Hetherington, Manchester,—"Certain improvements in machinery for preparing and spinning cotton, flax, and other fibrous substances."—3d.

Samuel Fisher, Birmingham, Warwick, engineer,—"Improvements in railway carriages, wheels, axles, buffer and draw springs, and hinges for railway carriage and other doors."—5th.

Edward Carter, Merton Abbey, Surrey, machinist,—"Improvements in printing calico and other fabrics."—5th.

Jonah Davies and George Davies, Albion Iron Foundry, Tipton, Staffordshire, engineers and ironfounders,—"Improvements in engines worked by steam, air, water, and other fluids, and whether locomotive, marine, or stationary, and also in boilers, the principle of which improvements is likewise applicable to blowing air and pumping water."—10th.

Jean Baptiste Ecarnot, France,—"Improvements in the manufacture of sulphuric, sulphurous, acetic, and oxalic acids, and nitrates."—10th.

David Christie, No. 3 St. John's-place, Salford, Lancaster, merchant,—"Improvements in machinery for preparing, assorting, straightening, teasing, tearing, doubling, twisting, braiding, and weaving cotton wool, and other fibrous substances."—(Being a communication.)—10th.

Thomas Grimsley, Oxford, sculptor,—"Improvements in the manufacture of bricks and tiles."—10th.

John Houghton Christie, 13 Craven-street, Strand, Middlesex, Esq.,—"An improved construction of wrought-iron wheels, and machinery for effecting the same."—(Being a communication.)—10th.

The Baron Louis Lo Presti, Paris, France,—"Improvements in hydraulic presses, which are in whole or in part applicable to pumps and other like machines."—10th.

William Holt, Preston-place, Bradford, York, organ-builder,—"Certain improvements in the construction of the pallets or valves of organ sound-boards or wind-chests, the same being applicable to seraphines, eolophons, harmonicums, harmoniums, and all other musical instruments, in which the tone is produced by the admission of wind supplied by bellows or other machinery to pipes, reeds, or springs, and played upon by a key-board or key-boards, and also to various other purposes connected with all the above-named musical instruments."—10th.

William Birkmyre, Fulbeck-cottage, Hampstead, chemist,—"Improvements in the manufacture and refining of sugar."—12th.

John Henry Jenkinson, Salford, Lancaster, machine-maker, and Thomas Priestley, Shuttleworth, same county, manager,—"Certain improvements in machinery or apparatus to be used for preparing, spinning, and doubling cotton, wool, flax, and similar fibrous materials."—12th.

IRISH PATENTS.

Sealed from 21*st October*, 1849, *to* 22*d December*, 1849.

Thomas Beale Browne, Hampen, Gloucester, gentleman,—"Certain improvements in looms, and in the manufacture of woven and worsted fabrics."—October 22d.

John Goodier, Mode-wheel, Manchester, Lancaster, miller,—"Certain improvements in mills for grinding wheat and other grain."—22d.

William Edward Newton, Office for Patents, 66 Chancery-lane, Middlesex, civil engineer, —"Certain improvements in steam-boilers."—(Communicated.)—November 6th.

Henry Knight, Birmingham, Warwick,—"Certain improvements in apparatus for printing, embossing, pressing, and perforating."—21st.

Pierre Armand, Lecomte de Fontainemoreau, 4 South-street, Finsbury (English and Foreign Patent Office),—"Certain improvements in weaving."—(Communicated.)—22d.

Alfred Barlow, Friday-street, London, warehouseman,—"Certain improvements in weaving."—14th.

Sir John Macneill, knight, Dublin, and Thomas Barry, Lyons, near Dublin, mechanic, —"Improvements in locomotive engines, and in the construction of railways."—24th.

John Combe, Leeds, Yorkshire, civil engineer,—"Improvements in machinery for heckling, carding, winding, dressing, and weaving flax, cotton, silk, and other fibrous substances."—24th.

Conrad William Finzel, Bristol, sugar-refiner,—"Improvements in processes and machinery employed in, and applicable to, the manufacture of sugar."—December 4th.

Charles Cowper, Southampton buildings, Chancery-lane, Middlesex, patent agent,—"Certain improvements in the manufacture of sugar."—4th.

George Simpson, Buchanan-street, Glasgow, civil and mining engineer,—"Improvements in the machinery apparatus, or means of raising, lowering, supporting, moving, or transporting heavy bodies."—11th.

William Buckwell, Artificial Granite Works, Battersea, Surrey, civil engineer,—"Improvements in compressing and solidifying fuel."—11th.

Robert Oxland, Plymouth, chemist, and John Oxland, same place, chemist,—"Improvements in the manufacture of sugar."—15th.

Robert Urwin, Ashford, Kent, engineer,—"Certain improvements in steam-engines, which may, in whole or in part, be applicable to pumps and other machines not worked by steam power."—15th.

SCOTCH PATENTS.

Sealed from 22*d October*, 1849, *to* 22*d December*, 1849.

Alexander Parkes, Harborne, Stafford, chemist,—"Improvements in the deposition and manufacture of certain metals, and alloys of metals, and improved mode of treating and working certain metals, and alloys of metals, and in the application of the same to various useful purposes."—October 24th.

Conrad William Finzel, Bristol, sugar refiner,—"Improvements in processes and machinery employed in and applicable to the manufacture of sugar."—24th.

William Edward Newton, Office for Patents, 66 Chancery-lane, Middlesex, civil engineer,—"Improvements in machinery for planeing, tongueing, and grooving boards or planks."—(Being a communication.)—24th.

David Owen Edwards, Sydney-place, Brompton, Middlesex, surgeon,—"Improvements in the application of gas for producing and radiating heat."—24th.

John Mercer, Oakenshaw, Lancaster, and William Blythe, Holland-bank, Oswaldhoistle, same county, manufacturing chemist,—"Improvements in certain materials to be used in the processes of dyeing and printing."—31st.

William Henry Ritchie, Brixton, Surrey, gentleman,—"Improvements in fire-arms." —31st.

Charles Cowper, Southampton-buildings, Chancery-lane, Middlesex, patent agent,—"Certain improvements in the manufacture of sugar."—(Being a communication.)—2d November.

Joseph Lowe, Salford, Lancaster, surveyor,—"Certain improvements in grates or grids, applicable to sewers, drains, and other similar purposes." —2d.

John Holt, Todmorden, Lancaster, manager of the Waterside Works,—"Improvements in machinery or apparatus for preparing cotton and other fibrous substances, parts of which improvements are applicable to machinery used in weighing."—5th.

William Buckwell, Artificial Granite Works, Battersea, Surrey, civil engineer,—"Improvements in compressing and solidifying fuel."—5th.

Thomas John Knowlys, Hegsham Tower, near Lancaster, Esq.,—"Improvements in the application and combination of mineral and vegetable products, also in obtaining products from mineral and vegetable substances, and in the generation and application of heat."—5th.

Henry Crossley, of the firm of Henry Crossley, Son, & Galsworthy, Emerson-street, Surrey, engineer and coppersmith,—"Certain improved modes or methods of, and apparatus for, heating and lighting, for drying substances, and for employing air in a warm and cold state, for manufacturing purposes."—7th.

Henry Knight, Birmingham, Warwick,—"Certain improvements in apparatus for printing, embossing, pressing, and perforating."—12th.

Adam Yule, Dundee, master mariner, and John Chanter, Lloyds, London, and Arnold Terrace, Bromley, Middlesex, gentleman,—"Improvements in the preparation of materials for coating ships and other vessels."—14th.

John Parkinson, Bury, Lancaster, brassfounder, —"Improvements in machinery or apparatus for measuring and registering the flow of liquids."—14th.

Alexander M'Dougall, Longsight, Lancaster, chemist,—"Improvements in recovering useful products from the water used for washing, and in treating wool, woollen and cotton fabrics, and other substances."—14th.

Peter William Barlow, Blackheath. Kent, civil engineer,—"Improvements in parts of the permanent ways of railways."—14th.

George Edmond Donisthorpe, and John Whitehead, Leeds, manufacturers,—"Improvements in preparing, combing, and heckling fibrous matters."—16th.

Walter Crum, Thornliebank, Renfrew, Scotland, calico printer,—"Certain improvements in the finishing of woven fabrics."—16th.

Alfred Barlow, Friday-street, London, warehouseman,—"Certain improvements in weaving."—19th.

Charles Edward Amos, Grove, Southwark, Surrey, engineer, and Moses Clark, St. Mary's Craig, Kent, engineer,—"Improvements in the manufacture of paper, and in the apparatus and machinery used therein; part of which apparatus and machinery is applicable for regulating the pressure of liquids, for various useful purposes."—21st.

Joshua Proctor Westhead, Manchester, manufacturer,—"Improvements in the manufacture of fur into fabrics."—21st.

John Jordan, Liverpool, Lancashire, engineer,—"Certain improvements in the construction of ships and other vessels navigating on water."—26th.

William Garnett Taylor, Burton Hall, Westmoreland, gentleman,—"Improvements in lint, and in linting machines, which improvements in linting machines are, in whole or in part, applicable to other purposes."—29th.

William Edward Newton, Office for Patents, 66 Chancery-lane, Middlesex, civil engineer,—"Improvements in stoves, grates, and fire-places, and in warming or heating buildings."—(Communication.)—30th.

George Buchanan, Edinburgh, civil engineer,—"Improvements in corks, valves, or stoppers, and in the use of flexible substances, for regulating or stopping the passage of fluids, and also in making joints of tubes and pipes, or other vessels."—30th.

Charles Moray, Manchester, formerly of the United States of America, gentleman,—"Certain improvements in machinery or apparatus for sewing, embroidering, and uniting or ornamenting by stitches, various descriptions of textile fabrics."—December 3d.

Thomas Worsdell, Birmingham, Warwickshire, manufacturer,—"Certain improvements in the manufacture of envelopes and cases, and in the tools and machinery used therein, part of which may be applied to other purposes."—7th.

John Macintosh, Berner-street, Middlesex,—"Improvements in furnaces, and machinery for obtaining power, and in regulating, measuring, and registering the flow of fluids and liquids."—10th.

Peter Fairbairn, Leeds, Yorkshire, machinist, and John Hetherington, Manchester, Lancashire, machinist,—"Certain improvements in machinery for preparing and spinning cotton, flax, and other fibrous substances.—(Communication.)—11th.

James Smith, Deanston, Perthshire, now residing in Glasgow,—"Certain improvements in treating the fleeces of sheep when on the animals."—20th.

Edward Lyon Berthon, Fareham, Southampton, clerk, M.A.,—"Certain instruments for ascertaining and indicating the course or way, velocity, time, and draught of ships, and the rates of currents; also, for discharging water from ships, and for taking altitudes and levels at sea or land."—20th.

DESIGNS FOR ARTICLES OF UTILITY.

Registered from 16*th November*, 1849, *to* 12*th December*, 1849.

Nov. 16th,	No. 2084.	William Leschallas, Budge-row,—"Metallic lock envelope."
17th,	2085.	Lutge and Co., King Edward-street,—"Attachment or connection between the linings and fur portions of lined fur articles."
—	2086.	Thomas Frederick Hale, Bristol,—"Plunge-cock."
19th,	2087.	William Machay, Woolwich, Quarter-Master Sergeant, Royal Artillery,—"Mercantile fountain-pen."
20th,	2088.	William Naylor, James-street, Oxford-street,—"Glass ventilator for window-sashes."
21st,	2089.	Charles Macintosh and Co., Manchester,—"Buckle."
—	2090.	John Elce and Co., Phœnix Iron Works, Manchester,—"Dynamometer."
—	2091.	Thomas Kitson Potter, Huddersfield,—"Victoria spirit-lamp."
—	2092.	Samuel Butler and Co., Birmingham,—"Revolving heel for boots, shoes, and clogs."
22d,	2093.	Reynolds and Tillcocks, New Bond-street,—"Ladies' haut-ton vesture."
23d,	2094.	Thomas Melling, Rainhill Iron Works, near Liverpool,—"Game register."
—	2095.	Lewis Le Richeux, Homerton,—"Spring for a spring neckcloth."
—	2096.	Gilbert Dickenson, New Bond-street,—"Comprehensive drawing folio."
—	2097.	J. and J. Holmes, Regent-street,—"Manifold cloak."
24th,	2098.	Francis Birkin Newton, Manchester,—"The Newton coat without seam."
27th,	2099.	William Burgess, Blackfriars-road,—"Gutta percha hose joint."
28th,	2100.	Francis Klamm, York-street, Commercial-road East,—"Rotary heel tip."
29th,	2101.	William Murray, University-street,—"Compensating ball-lever."
Dec. 1st,	2102.	William Broughton, South-street, Finsbury-market,—"Ne plus ultra stove."
3d,	2103.	Richard Bell, Basing-lane,—"Metallic fusee box."
4th,	2104.	Thomas Curry, Bristol,—"Configuration and arrangements of a steam boiler."
—	2105.	John Cocker, Bolton,—"Brush."
—	2106.	Samuel Whitfield, Birmingham,—"Window cornice and cornice-pole."
5th,	2107.	George Chance and John Bird, Kingsainford,—"Furnace grate."
7th,	2108.	John Smith, Uxbridge,—"The Royal Albert cultivator."
—	2109.	Henry and John Gardner, Strand,—"Improved magic stove."
—	2110.	William Woodward, Minories,—"Concave whelp for ships' windlasses and capstans."
8th,	2111.	Thomas Kitson Potter, Huddersfield,—"The Victoria spirit-lamp."
—	2112.	Edward Wallace Elmslie, Gloucester-road, Hyde-park,—"Ventilating sash-bar adapted to all kinds of windows."
—	2113.	Battersby, Telford, and Co., Waterloo Foundry, Liverpool,—"Self-revolving sheave."
10th,	2114.	John Grant, Hyde Park-street,—"The cottager's stove."
—	2115.	Mary Harvey, Cornhill, Dorchester,—"The Neapolitan stove."
—	2116.	John Sheringham, Kensington,—"Ventilator."
—	2117.	James Keithley, Bradford, Yorkshire, —"T-shaped boiler for heating buildings," &c.
11th,	2118.	Thomas Moxon, Leicester,—"Cheese bandage."

TO READERS AND CORRESPONDENTS.

Jacia.—Next month we shall make some use of his letter, although, from its length and general character, it is not exactly suited for producing entire. The error he mentions is really a very small one, but we agree with him in thinking that it would be better if we could avoid such faults, slight as they are.

Chloroform—Æther Chloricus.—*Chloric ether*, *Perchloride of carbon*, are the several names given to a liquid of an ethereal odour, obtained by the distillation of a weak spirit mixed with chloride of lime. The distillation is continued so long as a dense fluid, sinking in the water with which it comes over, is produced. For the other matters, read Smee on Electro-Metallurgy.

J. B. London.—The notes he mentions will be most acceptable.

A Mechanic.—His communication shall have a place next month, and meantime we shall compare the two arrangements. It is, however, unimportant—one succeeded, the other failed—and we are confident that the later inventor is not a copyist.

J. G. London.—His design has been received—any further particulars will be useful.

H. E. Engineer.—His idea seems to be a most ingenious one. We shall make use of it in our next number.

SIMPSON'S TURN-TABLE & SWING-BRIDGE.

Fig. 1.

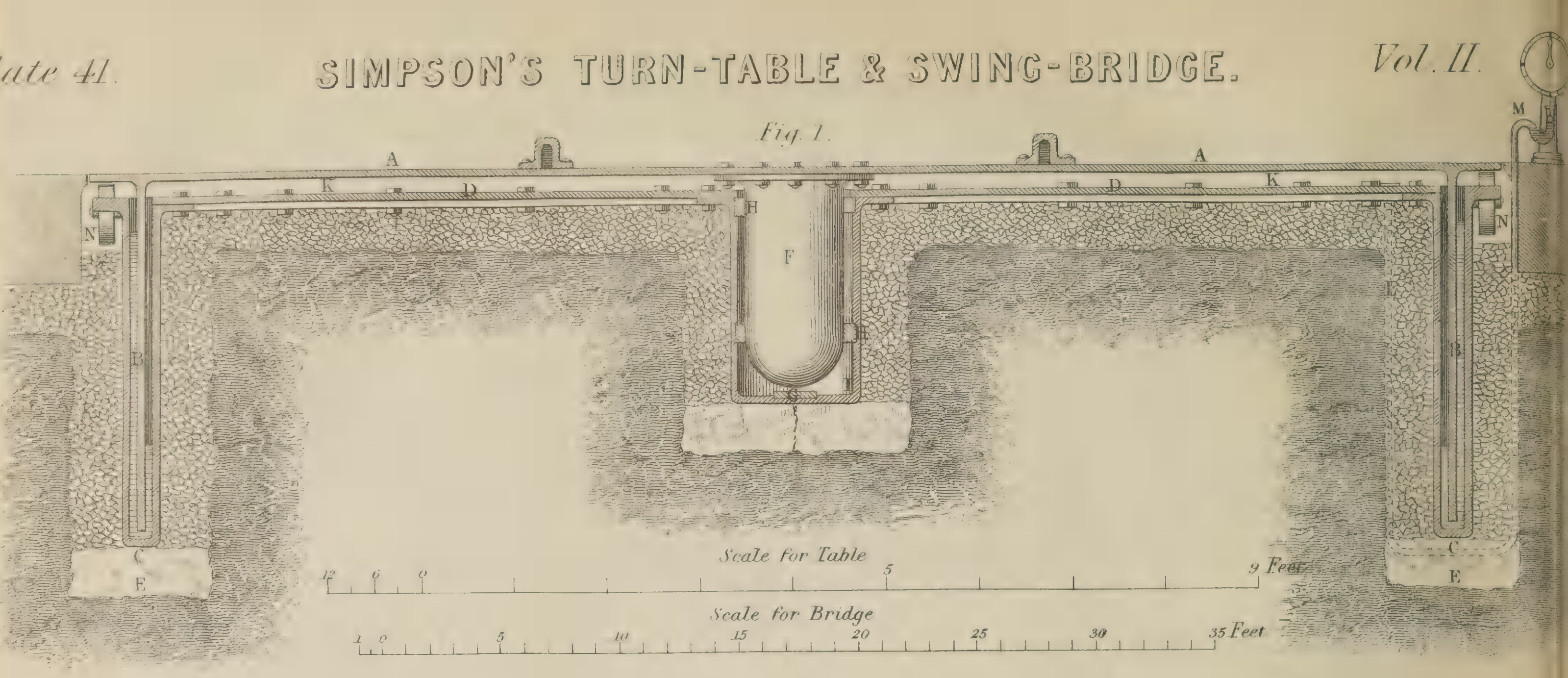


Fig. 2.

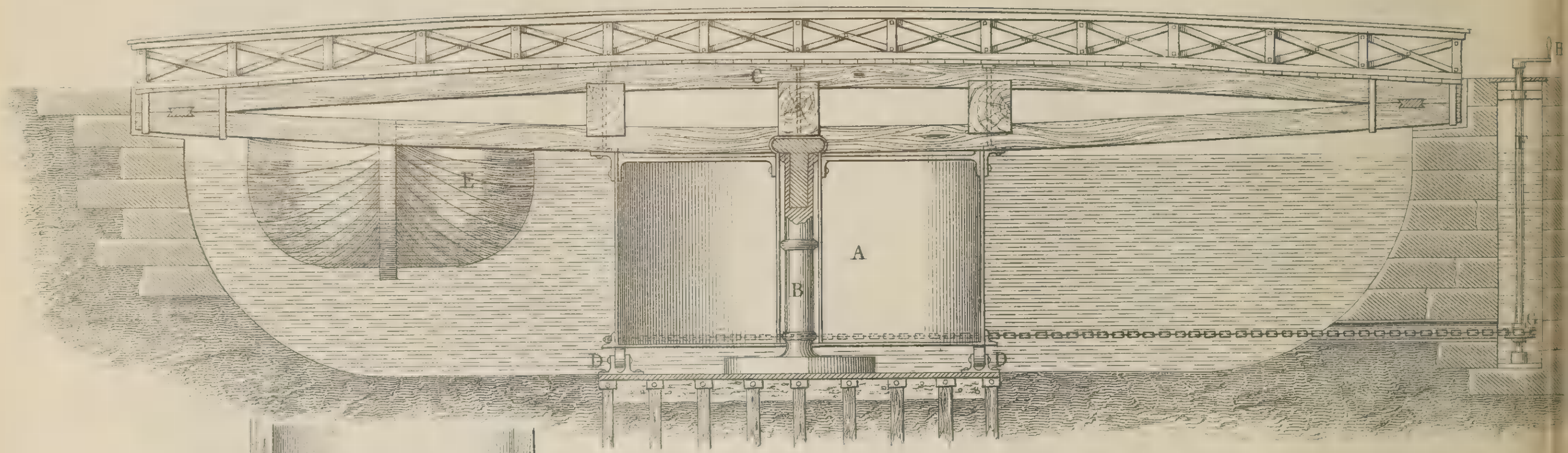
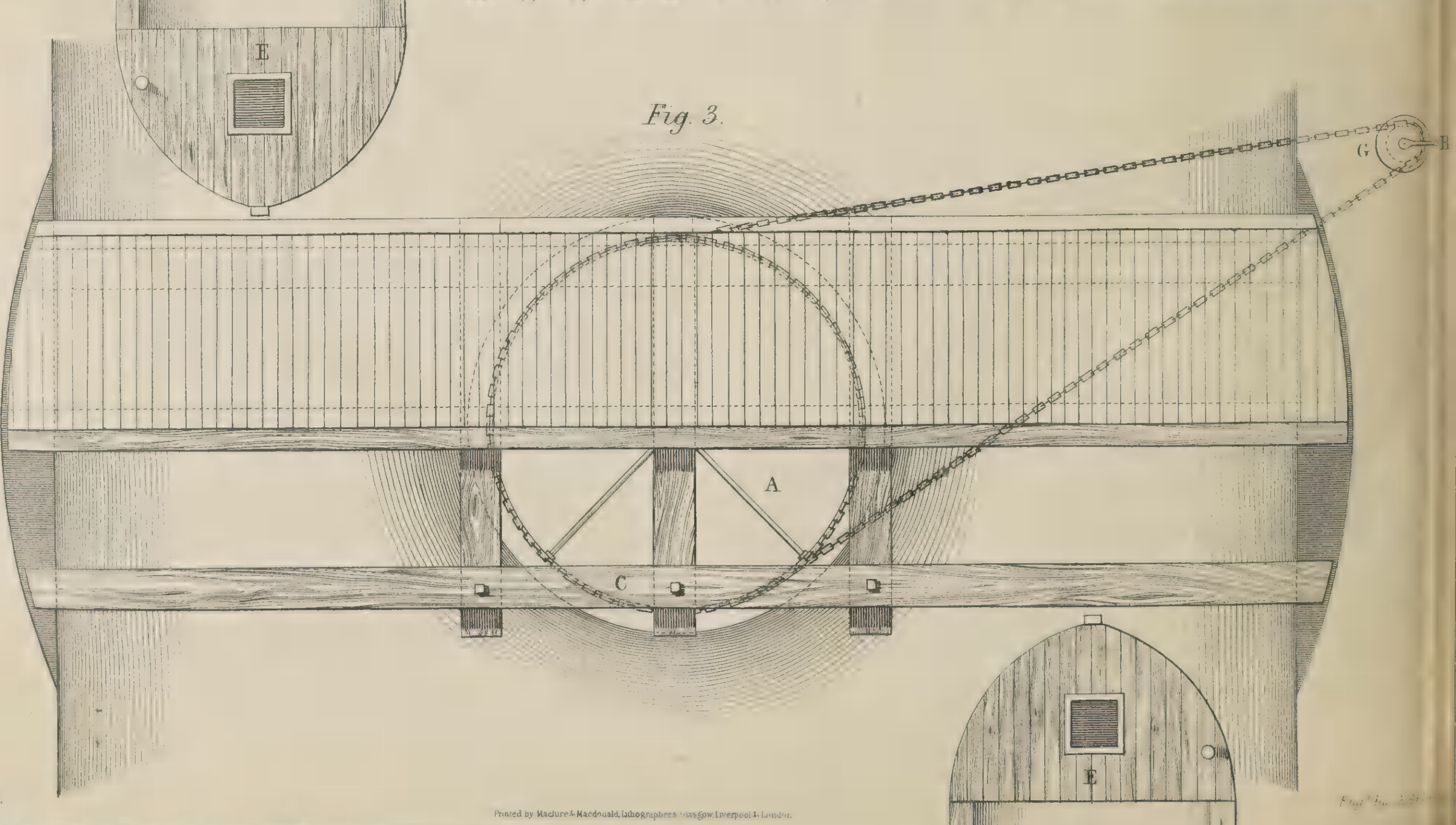


Fig. 3.



W. Johnson
Patent Office, Glasgow.

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RAILWAY ENGINEERING PROGRESS.

SIMPSON'S HYDRO-PNEUMATIC TURN-TABLE AND SWING-BRIDGE.

(*Illustrated by Plate* 41.)

Whoever has attentively watched the stream of mechanical improvements of the last few years, must have been impressed with a sense of the enormous amount of mental labour which certain branches of inventive production have monopolized in excess over others. In the department of railway mechanism, we have, as an example of what we mean, the very common-place contrivance of a turn-table. The time and talent expended upon this one article, during the limited period which has elapsed since railways became necessities of life, would, if cast up in the mass, astound us by its immensity; and yet the best modern practice has done but little towards perfecting it. Commencing with the simplest possible arrangement, as each defect made its appearance, every complexity in mechanism was tried as its remedy, until the improvements themselves accumulated to such an extent, as to far more than nullify the contemplated advantages of their addition. The example of table which we have illustrated in plate 41, affords a pleasing contrast to the mass of schemes of a similar class—for it is simplicity itself; whilst a glance tells us, what practice has actually confirmed, that its action in use is unapproached by any competitor. The credit of the invention is due to Mr. George Simpson, mining engineer, of this city, whose earlier mechanical contrivances have more than once contributed to the interest of the *Practical Mechanic's Journal;* and it has recently been secured by him under a comprehensive patent, a digest of the particulars of which will be found further on in the present number.

The name which we have given to the table sufficiently indicates the principle involved in its arrangement, and our drawing, fig. 1, of the vertical section of the table as fixed, will clearly show the materials and details which have been worked up in it. For the ordinary army of supporting pulleys, with the modern variations of hydrostatic pressure apparatus in the shape of miniature Bramah presses, with other like encumbrances, Mr. Simpson has substituted a simple plan of air-support, upon which the whole moveable apparatus of the table is carried. Air being a very portable, cheap, and, for many mechanical purposes, a most effective agent, has suffered endless enticements to act as a spring and supporting medium, and this with so much obduracy, that it is with some satisfaction that we find it so well managed as in the hydro-pneumatic turn-table.

We know that the atmosphere, at its average density, compared with water, is as 1 to 840, and, as Mariotte tells us, the elastic force of air varies exactly in proportion to its density, we may be tolerably certain that it must occupy a space as many times greater than water, and the respective heights of two opposing columns of air and water will be in accordance with the density. If we plunge an inverted goblet into water, however deep the immersion may be, the water will not entirely fill the space. The contained air will be compressed into a smaller space, and, at the depth of 34 feet below the water-line, the space will be only half filled, the air-space gradually diminishing with the increase of depth in the water. Thus it is that air may be made to support an excessive weight, by confining it so as to increase its density accordingly; and the experiment of the immersed goblet shows how this may be effectively done with the assistance of the denser medium—water.

In Mr. Simpson's turn-table, the platform, A A, with its circumferential ring, B B, represents the goblet as inverted; and here is the whole point of the contrivance. The platform is, in our plate, supposed to be cast in any suitable number of pieces, along with the deep ring, B B, the joints being made perfectly air-tight. The ring projects into a narrow annular water or oil chamber, C C, which is cast in a piece by itself, and bolted to the periphery of the under plate, D D, forming the bottom of the air chamber beneath the platform, resting upon a stone foundation, E E. The centre, F, is cast separate, and is bolted by a circular flange at the top to the lower surface of the platform; it is cylindrical and perfectly plain, being arranged to bear, when necessary, against a case-hardened bottom-piece, G, and case-hardened ring-pieces, H H, let into grooves formed in the interior of the cylindrical case or receiver, I. This case is bolted to the under surface of the bottom plate, D D, and rests upon a stone foundation sunk in the earth. Thus arranged, the platform top is perfectly flush, and quite free from any ugly and inconvenient projection at the centre. The deep excavation ordinarily required is entirely dispensed with, and no underground work is required further than the extent we have shown—the bottom plate, ring, and centre, being simply laid in the earth with a six-inch layer of broken slag, or road metal, as a support. The annular liquid-chamber is made just sufficiently deep to oppose the requisite fluid pressure to the escape of air enclosed in the space, K K, upon which the whole weight of the table with its load is supported; and, being very narrow, a very inconsiderable quantity of fluid is required to form the joint, so that oil, or any suitable fluid compound, may be used in place of water, if the latter is found objectionable on the score of loss by evaporation, or the action of frost, without involving any appreciable expense.

To show the state of the internal air-pressure, a tube, L, is placed to open into the space, K, being passed downwards through the earth, and beneath the annular fluid-chamber, with a corresponding bend upwards, where it may either terminate in a graduated glass indicating pipe, or, as we have represented in the plate, in a bent mercury tube, M, fitted with a float, acting upon an index, which points out the degrees of pressure upon a fixed dial, carried by a short pillar on the edge of the coping. By this simple means the table is made to combine with its ordinary office that of a weighing machine, for which purpose the frictionless air-support is peculiarly applicable; and any derangement of the indicating action, arising from the evaporation of the fluid in the annular chamber, or the effect of thermal variations, may be easily rectified by a comparison of the zero of the index with that actually given by the unloaded table, and a re-adjustment of the index to make the two correspond. It will be seen that there is actually no working contact of parts in this table, if we except the slight bearing action of the centre against the ring-pieces in its containing chamber, for the mere purpose of retaining the platform in its concentric position in reference to the fixed ground-work. It is only in extraordinary cases of the presence of excessive weight upon the platform, that any frictional pressure occurs; and then the rounded end of the centre, which, in regular work, revolves quite clear of its bottom piece, G, comes to a bearing, whilst the ring of pulleys, N N, carried by the flange of the annular chamber, C, receives the platform itself, and takes off the objectionable strain from the edge.

In applying a medium like air as a comparatively unyielding support for the heavy loads of railways, where perfect uniformity of level is essentially necessary for agreement with the surface of the rails, to avoid the jarring and disagreeable action found in common tables, one or two apparently important objections present themselves. How far these objections really affect the working of the arrangement, we shall now proceed to show. The variation of the bulk of air under thermal changes amounts to $\frac{1}{493}$ for each degree of Fahrenheit—that is, whatever may be the elasticity of the air at 32°, that elasticity is affected to the extent of $\frac{1}{493}$, if the temperature is raised to 33°.

Again, water, which is supposed to be the medium employed to form the bar to the escape of the enclosed air, varies between 32° and 212°, at the rate of $\frac{1}{21\cdot5}$ of its bulk. If we take the two points 32° and 90°, as the limits of the variations between winter and summer heat, we find that the extreme effect upon the air will be represented by the formula—$1 : \frac{1}{493} :: 58$, or $\frac{58}{493}$, being something less than $\frac{1}{9}$th of the original bulk. For all practical purposes, the variation on the second count cannot be considered as affecting the case; at least it would appear that the total variation can never exceed $\frac{1}{70}$th.

In our illustration, the diameter of the platform of the table is 15 feet, the depth of the annular chamber is 4 feet 6 inches, and the space between the platform and bottom plate is 2 inches, being purposely made narrow to reduce the effect of change of temperature. Taking 33·4 feet as the height of the column of water necessary to balance the atmospheric column of $14\frac{1}{2}$ lbs., we shall have, for the depth of 4 feet 6 inches, an opposing water column of 1·9 lbs. nearly. Or, if mercury is used in place of water, the necessary equipoising column for the atmospheric weight being 2 feet 6 inches high, the mercurial ring would give a columnar pressure of 26·1 lbs.; or, in other terms, a mercurial column of 4 inches would answer the same end as the 54-inch water column. We have said that the diameter of the table in our plate is 15 feet, but to suit our own purpose we will make the diameter of the air-space equal to 16 feet; and to find the total supporting pressure of the air upon this area, under the 54-inch column of water, we have 201 square feet—the effective area of the table—which, at the pressure of 1·9 lbs. per square inch, gives us a supporting power of 54993·6 lbs., or about $24\frac{1}{2}$ tons. Allowing, then, $4\frac{1}{2}$ tons for the weight of the platform, ring, and centre, we have an available power of 20 tons as a support for passing locomotives. From these data, with the atmospheric column at $14\frac{1}{2}$ lbs. with an opposing upward pressure of $14·5 + 1·9 = 16·4$ lbs., it appears that the actual compression of the air is merely $\frac{1·9}{14·5}$, or about $\frac{1}{8}$th of its whole bulk, reducing the 2-inch stratum of air beneath the table to $1\frac{3}{4}$ inches; or, if the allowance is to be made originally, the space must be set out at $2\frac{1}{4}$ inches, to leave a final stratum of 2 inches.

As the platform has no holding-down apparatus whatever, it would appear at first sight that a weight of 20 tons upon it would cause a direct depression of $\frac{1}{4}$ inch. But this is not really so; for, after allowing for the weight of the table itself, and for the fluctuation of the column of water by reason of the upward or downward movement of the ring in the annular chamber, the variation is actually no more than $\frac{1}{16}$ inch.

In order to insure the greatest delicacy of action of the table in turning with a weight, it is necessary that the engine or carriage should bear directly upon the centre of the platform; and for the exact accomplishment of this, Mr. Simpson has introduced the arrangement represented in the accompanying woodcuts, figs. 1 and 2, where fig. 1 is a plan of the apparatus, with a half-plan of a carriage, the wheels of which are just taking up their position on the table. Fig. 2 is an elevation of the stop-lever, showing the action of the carriage-wheel upon it. The stop-lever, A, of the shape shown in plan, is slotted down the centre, to work upon the two upright fixed pins, B B, being constantly pressed inwards, along these pins, towards the centre of the table by the spring, C, bearing against a fixed stop, D. At E, a short vibrating catch or lever is set loose upon a pin in a slot cut in the rail, and in such a position as to allow the flange of the carriage-wheel to bear upon its inner end, as in fig. 2. When the carriage is run upon the table, the flange of its first wheel bears down the catch, E, so as to cause its opposite end to bear up the end, A, of the stop-lever, with its two projecting arms, F F; any two of the notched or angled parts of which will then fit in between, and form stops for the pair of wheels of the carriage, holding it in its correct central position on the table. After turning, the stop-lever is drawn out of gear with the wheels by the disengaging lever, G, and the catch, E, being released from the action of the flange, the carriage is then free to pass off.

Fig. 1.

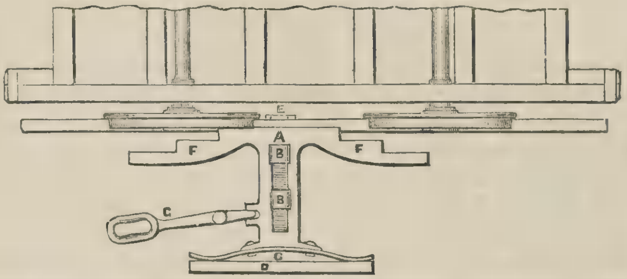
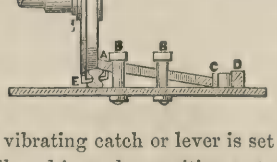


Fig. 2.



In the inventor's original scheme, the arrangement differed very materially from that represented in our plate. The platform was of wrought-iron, having the projecting ring of boiler-plate bolted to it. In place of a single flat plate, the bottom was formed by radial beams carrying the annular water-chamber of cast-iron—the bottom of the air-space beneath the platform being filled in with asphalte to form an air-tight chamber The centre was bolted down to the bottom beams, and passed through the platform, having a flanged head screwed on the top, and, to prevent the escape of air at the centre, a hydraulic joint, precisely similar to the large annular joint, was formed round it. Subsequent experiments and calculations threw more light upon the matter, and the simplified modification which we have described was the result.

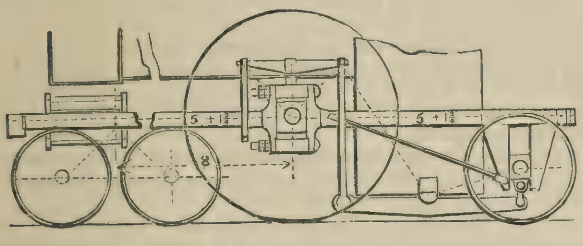
Although not, strictly speaking, an example of railway mechanism, we have here introduced Mr. Simpson's improved swing-bridge, which is proposed to be constructed either on the plan of the turn-table, or according to figs. 2 and 3 of our plate. In the latter case, the support consists of a buoyant air-vessel, turning upon a fixed centre pillar, and carrying the bridge platform on its top. Fig. 2 is a vertical section of the bridge, represented as spanning a canal; and fig. 3 is a corresponding plan, with one-half the roadway removed. The buoyant vessel, A A, is a plain cylinder of wrought-iron, with flat ends, placed upright on a centre, B, bolted down by a wide bottom flange, to a plate or beam laid on piles in the centre of the water-way. An air-tight tube passes up directly through the centre of the vessel, to allow the centre pillar to pass through to the upper surface, where a cap-piece is screwed on to receive the upward pressure of the vessel, and retain the platform at the level of the roadway. Projecting rings are formed at intervals upon the centre to bear against the interior of the tube; or, instead of this, the centre may be made plain, to bear against loose ring-pieces, as in the turn-table. The platform for the roadway is carried by the three double-trussed timber beams, C, bolted to the top of the air-vessel, and these are assisted by a couple of tension-rods on each side, the whole being surmounted by a neat diagonal frame-work railing. To receive the excess of weight of passing bodies over the buoyant power of the supporting vessel, a ring of pulleys, D D, is placed on the bottom plate in the canal, so that, when necessary, the air-vessel may come down upon them as upon a temporary bearing.

The centre of the air-vessel being in the centre of the water-way, it is necessary to make the latter sufficiently wide at this point to admit of the passage of boats through the space left between each side of the air-vessel and the edge of the masonry, so that, when the bridge is turned in a direction parallel with the course of the canal, as indicated by the dotted lines in fig. 3, a free passage will be left for boats, E E, in any direction. The change of position of the bridge may be effected in various ways, as by a toothed wheel on the top of the fixed centre standard, to be driven by a pinion carried on the platform, or by a chain connection, as in ordinary swivel-bridges. The latter plan is the one adopted in our plate—a narrow well being sunk in the masonry at the edge of the canal to receive a vertical shaft, F, having a pulley, G, at its lower end, carrying an endless chain passing through a tube or passage in the masonry, and round the air-vessel. The winch-handle, H, employed in working the chain, being capable of unshipping, no inconvenience results from its temporary projection above the level of the towing path. For a single swivel-bridge, with only one water-way for boats, the air-vessel may be placed at one end of the platform, and in such a case it would be sunk at one side of the canal, allowing the boats to pass outside it. It is evident that the air-support of the turn-table, fig. 1, may be adopted for bridges of this class, in place of the buoyant vessel; but either arrangement appears to offer the highest advantages in point of smoothness and ease of movement.

The rigid jarring action, so justly complained of in our present railway turn-tables, may be said to be entirely obviated by the introduction of the air-support. It possesses the extreme of firmness, with, at the same time, a certain partially elastic quality; and to these good points are to be added, a perfect equality of movement, almost devoid of friction; and, lastly, the mechanism is cheap.

AMERICAN ENGINEERING.—LOCOMOTIVES.

SUPPLEMENTARY NOTE.



3-16th = 1 foot.

We now give the sketch of the locomotive engine frame, referred to last month at page 220, as fig. 3. The dotted lines represent the manner in which the engine is balanced on its frame when only one pair of drivers is used. The author of the article referred to states, that the engine, from which the drawing was made, works remarkably well, being quite steady and free from oscillation, at a speed of 40 miles an hour, through curves which an English engineer would hardly like to pass through at a much slower rate. The details of construction will be readily understood, on referring back to the remarks upon it in the January number.

ANALYSIS OF PRODUCTION.

A CHAPTER ON POLITICAL ECONOMY.

> "A national community should be constituted for the good of all its parts, not to be obtained by them as detached independent portions, but adjusted and compacted into one social body; an economy in which all the parts shall feel they have the benefit of an amicable combination; in other words, that they are the better for one another."—*Foster's Essay on Popular Ignorance.*

Wealth, for the creation of which the entire community combines, has three principal phases: it is first *produced*, then *distributed* through the community, and, lastly, *consumed*. The study of the laws of production is an indispensable preparation for entering upon the subjects of distribution and consumption. We, therefore, propose, in the present paper, to analyse the meaning of the word Production, and to examine cursorily the various processes which result in the formation of a commodity possessing value.

Although man is unable to create a single atom of matter, yet, by bestowing labour upon natural objects, he can give them qualities which they did not previously possess, or he can increase the qualities which they have already; and he can thus create VALUE. By value must be understood the capacity of satisfying human wants and desires, and its original and fundamental idea is utility. The operation of moulding things, so as to render them capable of satisfying human wants and desires, is termed production. To produce is, therefore, to create value, and this is the department of industry.

It will be found on inquiry, that the operations of industry are limited to the separation, combination, transformation, and transportation of the particles whereof material things are composed. A farmer takes seed, and places it in the ground along with manure. After certain operations which experience has taught him, he finds that natural laws, acting upon the seed through the agency of the soil and the atmosphere, convert it into plants or herbage. By using a sheep, which may be considered as an instrument endowed with life, he converts the herbage into wool. The wool is purchased from the farmer by a manufacturer, who cleans, cards, and spins it, and then makes it into a web, which, being dyed, fulled, and dressed, appears as the cloth of which our garments are made. A merchant undertakes to convey from one place to another the wool, the cloth, and the articles with which it is dyed, fulled, &c., so as to facilitate the operations of the manufacturer, and place the finished article more readily at the command of the consumer.

The various operations we have described are analogous. When a dyer combines in his vats, water, alum, indigo, and other matters, he goes through labours in some degree similar to those of the farmer, who, according to the practices of his business, combines water, manure, and the juices which earth and air place at his disposal. The dyer calls to his aid the artificial heat of fires and stoves; the farmer the natural heat of the sun. The dyer intrusts his stuffs to the boiler, as the farmer intrusts his seeds to the ground.

In the operation of producing, man does nothing more than originate motion, or impress a direction. He who ploughs guides a moving force which tears open the ground, and renders it more fertile. In manufactures, the most ignorant operative, the most skilful mechanic, merely originate motions, with only this difference, that the result in one case is calculated beforehand, in the other not. Again, the labours of the chemist are confined to the combination and separation of bodies; he is the occasion, but not the cause, of the phenomenon.

Production, therefore, when thoroughly analysed, is seen to be an application of force, or a direction of motion, yielding something which is capable of satisfying human requirements. And that something is not, as M'Culloch and other writers have said, a commodity fitted to be exchanged, since such a definition may lead to the belief that only value in exchange is wealth, whereas wealth comprises value in use as well as value in exchange.

We will now show that, in the true acceptation of the words, *all industry* is productive of *wealth*, or analogous things; and that to impart useful qualities and properties to human beings, is still to produce or to create wealth.

The property of usefulness may be created so as to have the capacity of satisfying a want, and of becoming the subject of barter, without being incorporated with a material object. A physician, an advocate, produce what is useful, what satisfies a want, and something they can dispose of for money. It may be an immaterial commodity, but it is real and analogous (economically speaking) to a material commodity. By mistaking the language of Adam Smith, a number of writers, including Malthus and Sismondi, fell into an error with respect to immaterial commodities, which induced them to divide labourers into the two classes of productive and unproductive. Smith, it is true, has advanced that the labour of the domestic servant is productive of nothing; but the fact is, that the servant's labour enables his master to apply himself to some other species of labour. It may be answered that an excessive number of servants is wasteful. That may be so; but it is just as wasteful to keep ten horses, when one would suffice; or to spend ten thousand pounds in building a house, when a house to answer the purpose could be built for half the sum; or to throw one's money out of the window.

There is, therefore, no labour which is unproductive, except that which produces absolutely nothing, such as the senseless efforts of a madman.

If we take care to distinguish between labour (industry) and its results, light will be thrown upon the point under consideration. The exercise of every useful profession, whether concerned with men or things, is attended with labour, makes use of processes which are exhausted by exercise, and creates that which has usefulness—to wit, improvement, which is capable of accumulation. Thus the professor's lesson is spent at the same time that it is given, just as much as the trouble of the potter is spent in fashioning clay; and the impression made on the mind of the pupil is a permanent result, as much as the vessel constructed out of the clay by the potter. The productions of the physician, the orator, the singer, are not simply and finally the prescription, the oration, the melody, but they are to be looked for in the modifications which they occasion in the persons upon whom they operate, in their health, &c.; and such productions are capable of preservation, increase, and accumulation. In truth, the form and colour bestowed by the artisan upon brute matter, are things quite as immaterial as the knowledge communicated by a professor to his pupils. The labour of both is expended in producing what is useful; and the only real difference between their performances is, that one modifies things, the other men.

The productions of that labour which is not employed upon things, or rather which is employed only indirectly upon things, are excluded by some writers from the domain of political economy. Yet it must be admitted, that the productions of the professor, the physician, and the orator, have reference to something, since they have reference to living beings, as the productions of the spinner, the weaver, and the dyer, are realised in things. It cannot be said that it is impossible to barter them, because in fact they are daily bought and sold, conformably to the law of demand and supply, and proportionally to the cost of their production. It cannot be said that they are not capable of accumulation, because talents of every kind are susceptible of considerable increase and enhancement; and the value of a professional practice may be increased like that of any other business.

Consequently it is not accurate to say, as Malthus has said, that immaterial wealth is less susceptible of preservation. Knowledge and scientific acquirements increase, and continually enlarge the patrimony of the human race, just as effectually as material wealth, with this difference, that the first species of wealth is multiplied by use, whilst the second is wasted by consumption.

It cannot be said that it is disadvantageous to multiply the labourers in this field of production, unless we refer to an excess in their number over the requirements of society, and in that case it is an objection that applies equally to an excess of population, or to an excess of production generally.

It cannot be said that immaterial productions add nothing to the national capital, because the health, taste, imagination, moral habits, and knowledge of the labourers afford means of producing quite as perfect as machines, money, and other capital; and because societies are enriched only by the cotemporaneous creation of these two kinds of wealth, which together form social wealth.

The principle has been sufficiently demonstrated. It has however been objected, that nothing remains after the use of the consumption of an immaterial production. What, it is asked, remains after the singer has finished his song? The recollection of it; and whilst we admit that the recollection, and the pleasure it occasions, have no directly useful result, yet we may ask in turn what remains after the consumption of bread and wine (which are certainly natural things), unless we except the health of those who have eaten them; and in that case we must recognise the value of the physician's labour, which rectifies a man's physical deficiences, and the value of the clergyman's instructions, which improve his moral qualities.

When government is what it ought to be, it is a producer of men obedient to public order, and disciplined in the practice of justice. A true moralist is a producer of moral men. A good artist is a producer of men of taste and feeling. A teacher of fencing, of horsemanship, gymnastics, a physician, are producers of agile, robust, and healthy men. In other words, health, strength, taste, and morality, gain and are repaid by other productive powers of society. All these productions are productions of wealth whenever they are useful, and they have a value in exchange when they are not offered in too great abundance. By neglecting or denying these truths, a number of important productions is kept out of view, and the real services rendered by the honourable professions are mistaken.

We may now proceed to a consideration of the composition of industrial labours. The construction of most articles of trade requires the co-operation of several labourers. There is—1st, the labour of the thinker; 2d, that of the employer, manufacturer, contractor, &c.;* 3d, that of the operative. The philosopher or thinker discovers, the manufacturer applies, the operative executes. Philosophers are always necessary in the discovery and accumulation of knowledge, although operatives and their employers need not be chemists, or physicians, or mechanicians. If philosophers and their writings should become extinct, although the arts would go on for a time by their own impulsion, they would soon fall into a blind routine, and practice ceasing to be corrected by principle would gradually degenerate. But it is needful that science should be applied, and the application, whether pointed out or not by the philosopher, falls to the lot of the employer. His duty is to make himself acquainted with the requirements of the public, its tastes and power of purchasing. Since, however, the employer is unable to carry out his plans unassisted, the operative is called in to execute the different processes required.

It may be that the same person undertakes the three several duties we have indicated. On the other hand, there is not an article of commerce in which we may not find traces of the three species of labour. Fruit, for example, appears to be only the product of the soil's fertility. But it is necessary to get together the materials of cultivation, to consider the means of applying them, to find a market, &c.

It will appear that the employer is the principal agent of production. In order to produce exchangeable commodities, that is to say, in order to realise the discoveries of the philosopher and the labour of the operative, in understanding the requirements of the public, and in ascertaining the best means of satisfying them, he ought to possess, as a principal faculty (over and above the special knowledge of technical details), a sound judgment, and that union of qualities constituting a talent for business.

Of the Instruments of Industry.—The rudest kind of industry cannot dispense with instruments. The savage has arms, nets, tools for erecting his habitation, and skins to clothe himself. In a civilised state, the instruments employed are in great number and variety. Of these instruments, some, like the wind, the powers of nature, &c., are instruments freely at the use of all the world, and hence they may be styled *unappropriated* natural instruments. Nature also furnishes man with the productive power of cultivable land. She supplies him with metals, stone, coal, &c., in which things some men have gained a property to the exclusion of others, and hence they may be named *appropriated* natural instruments.

Amongst the latter class of instruments the most important is cultivable land, divided amongst a greater or less number of owners. This forms what is termed landed property, or simply, LAND.

Other instruments are not the creation of nature, but are the fruit of industry itself. Such are tools, machinery, buildings, sums of money, &c., which are used in the process of production, and are styled generally, CAPITAL.

When real estate has buildings, drains, and what are termed improvements, upon it, these, being the product of industry, are to be considered as capital united to land, an appropriated natural instrument. These two kinds of instruments, although differing in their origin, usually belong to the same person.

But these are not the only instruments of production. Amongst the appropriated natural instruments there is one of great influence, the physical powers of man, otherwise, LABOUR.

To sum up, the economist designates the chief appropriated instruments of production as Land, Capital, and Labour, terms which are, indeed, somewhat unsuitable, since the word land does not express all the appropriated forces of nature, and the term labour rather indicates the act than the power, the effect rather than the cause. And as to the word capital, common parlance usually assigns to it a sense too exclusively monetary.

The differences between these three instruments are great. Labour and land are primary forces; capital is merely a result—it is the result of economy applied to reproduction. Labour, as a motive power, is not transferable; capital and land, on the contrary, are regularly and legitimately in the market.

Capital has been justly styled accumulated, funded, or invested labour; and acquired talents are to be deemed a species of capital which may be termed immaterial capital. Capital and land can be estimated by the price they would fetch if taken into the market. As to immaterial capital, which is not alienable, it cannot have a quotation in the market, but its value may be estimated by the profit which it makes, and the remuneration it commands.

The funds or sources of all national production are, therefore,

1. The common or unappropriated instruments afforded by nature, such as the sea, streams of water, the air, the powers of nature, &c. &c., which are at the command of everybody.

2. The natural instruments which have become appropriated, comprising—

Land,……Cultivated ground, springs of water, mines, &c.
Labour, { The labour of the philosopher, inventor, &c
The labour of the employer, *i.e.*, the cultivator, manufacturer, merchant, &c.
The labour of operatives, the agents, more or less intelligent, of the employer.

3. Artificial or acquired instruments, viz., capital, comprising all products (merchandise, machinery, buildings, money, &c.) resulting from an anterior application of labour.

Of the Respective Functions of the Three Instruments of Production.—The ultimate source of all consumable articles will be found to be land, and the grand means of realising that source is labour, mental or physical. In order to facilitate the ends of labour, man makes use of the results of his previous labours, in the shape of tools, provisions, &c., in other words, of capital.

In capital we may distinguish two kinds: that which labour has realised in things, and that which it has developed in men, mentally or physically.

In order to produce, it is necessary to bring into play the three instruments of land, capital, and labour; and it may be shown that the full effect of labour and capital is only brought about when they are applied on a large scale. The employer of labour hires land or capital. The operative, whose only possession is his power of working, lets out his labour to some one who is able to combine it with other means of production, and who, under the general name of employer, or the particular ones of farmer, manufacturer, merchant, &c., directs them to one common end, the formation of commodities. The possessor of capital, or the capitalist, has the power of deriving a profit from its employment, which profit is termed *rent* when drawn from an investment in land, *interest* when derived from a loan to others, and simply *profit* when proceeding from trade. The landed proprietor may derive a profit from his land either by actually occupying it, or by letting it to another and receiving a rent. The person who lets out his personal services receives in return a remuneration in the shape of *salary* or *wages*.

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* We have unfortunately no word to express the person who sets the labour in motion by the aid of capital, corresponding with the French *Entrepreneur*, but we shall style him in this paper the Employer, meaning thereby to include, under one term, the manufacturer, the contractor, the farmer, &c.

A product or commodity is the result of a design in which a number of means is selected to one end. It is usually the employer who forms the plan, and who combines the different instruments to realise it. But he is not the only producer, for all operatives, and possessors of instruments, concur in producing. The operative and possessor of immaterial capital give up their time and talents, and bestow trouble, in order to contribute to production. The proprietor of land might keep it as a park, instead of devoting it to agriculture. A capitalist might spend his money upon his personal gratification, instead of employing it productively. Thus landowners and capitalists ought to be classed, if not as producers, at least as having a claim to a share in the results of production; for the landowner produces by means of the productive properties of his estate, the capitalist by means of his capital, just as the operative produces by means of his labour. But, of course, to do this, the land must not lie waste, nor the capital idle.

It is evident that the same person may assist in production under different characters, and be at once landowner and capitalist, employer and workman. In general, the employer is more or less of a capitalist; and even the workman usually possesses some little capital in the shape of tools.

When an unappropriated natural instrument is the source whence commodities are drawn, such as the sea, from which fish, pearls, coral, &c., can be obtained, commodities are the result of labour and capital alone. In manufacturing and commercial industry, labour and capital are also frequently sufficient to the same end, land not being absolutely necessary, or being, at least, of less importance, since we can only give the name to the site of workshops and warehouses. But we must not forget that the things operated upon by these two instruments originate in land. It follows that the manufacturing and commercial industry of a nation are not limited by the extent of its territory, but rather by the extent of its capital. Numerous cases may be cited in support of this proposition. The Genoese, who live in abundance, have a limited territory, not producing a tenth of what is necessary for their subsistence. The people inhabiting the barren gorges of the Jura, near Neufchatel, are in comfortable circumstances, because they exercise several mechanical arts. Venice, in the 13th century, without having any territory in Italy, became rich enough by her commerce to conquer Dalmatia, the Isles of Greece, and Constantinople.

The instruments we have described severally contribute their peculiar services to the act termed Production, and we may expect to find that those services are respectively represented in the value of the produced commodity.

Production may be considered as a grand exchange, in which all the producers contribute all that constitutes the cost of production, in order to obtain a commodity representing some degree of value. Now, it is at least requisite that the value of what has been consumed should be balanced by the value of what has been produced. In taking this view of production, it is easy to perceive what it is that constitutes the industrial progress of a nation. When a nation increases its productions without increasing the cost of producing, or, what comes to the same thing, when it produces a like quantity at a less cost, then there is progress. At first it is the producers who gain from this progress, since they continue to receive the same price for that which costs them less. But when a knowledge of the more economical process gets abroad, then competition brings down the price, and the rate of profit is much the same as before. It then becomes the consumer's turn to benefit by the discovery.

It is plain that, if the cost of producing a commodity is so much lessened, that the price is lowered one half, it is the same thing as enabling the consumer to purchase twice the quantity at the old price. It is thus clear that industrial progress is advantageous to consumers, that is, to the whole society.

When a manufacturer is able to produce more commodities at the same cost, he can afford to sell them at a cheaper rate; and the more he lowers their price, the more purchasers will he find. To be at the same trouble and risk for the same profit would not answer his purpose; but besides the consumer gaining, it almost always happens that, by improvements in the process of manufacturing, production is as easily accomplished on a large scale as on a small one.

A diminution in the cost of production cannot be effected without lessening the quantity produced, except by deriving a larger amount of labour from those appropriated instruments, the services of which it is necessary to purchase; or by supplying the place of such instruments by the gratuitous services of unappropriated natural instruments. Thus, if, instead of allowing the land to lie fallow every fourth year, another species of crop can be raised upon it in that year; or if a manufacturer employs one set of workpeople through the day and another through the night, so as to derive the greatest possible amount of service from the buildings and machinery in a given time, these are examples of the first mode of diminishing cost without lessening the quantity produced, or, what is the same thing, of increasing the produce without increasing the cost of production. As an instance of the second mode (and here lies the field of the great conquests of inventive genius), we may cite the wondrous assistance we derive from steam confined in cylinders of iron, and compelled to do the work of millions of horses. The power which now does us so much service had lain slumbering in steam ever since the creation, but was only discovered and applied to a useful purpose the other day. What revolutions may we not look for in the manufacturing arts, and even over the whole face of civilization, by the future discovery or application of powers equally simple and equally grand!

Classification of Labour.—The production of commodities may be described as the taking raw material and giving it a greater worth by the incorporation of labour or industry. Notwithstanding the multitude of arts, their end is always effected by an expenditure of the same kind of labour; but the process will be better studied by forming groups of those arts which have a closer connection than the rest. The labours of agricultural industry may be considered apart from those of manufacturing industry, and those of commercial industry may be distinguished from both the preceding.

Under the name of agricultural industry we may arrange all those labours that are employed in extracting a raw material from its natural place of deposit, thus including not only the labours of the farmer, but those of the fisherman, the trapper, the miner, &c. In the class of manufacturing industry may be comprehended all those labours that are employed upon a raw material after it has been extracted from its natural place of deposit, even when the material so dealt with is only designed for private use. Thus all the labours of a woman in her own house are, rigorously speaking, manufacturing labours. Finally, under the head of commercial industry, all the labours which are limited to buying with a view to sell, not dealing with the commodities except in the way of transporting them from place to place, and dividing them into parts, so as to place them at the command of the consumer where and in the bulk that he requires.

It has been urged, however, that since all the operations of nature and art are limited to transmutations and exportations, that is, to changes of form and changes of place, all labour may be brought under two heads, viz., that which is concerned with change of form, or manufacturing industry (wherein is comprehended agricultural industry), and that which is concerned with change of place, or commercial industry. But it must be observed that there is hardly a single occupation which does not combine labours that belong to both these classes. The vine-grower is a manufacturer when he places his grapes in the press and expels their juice; the gardener is a merchant when he carries his vegetables to market; and even the merchant entrenches on the province of the manufacturer, to the small extent that he works upon his goods before transferring them to others. Every household with a kitchen garden must carry on agricultural labours to some degree, and have a workshop in its kitchen.

The relative importance of the different kinds of labour has been frequently the subject of dispute. As long as gold and silver exclusively were deemed wealth, and production thought to be only exemplified by means of the precious metals, America was considered the most productive country of the globe. Those who upheld the mercantile system, or the balance of commerce, asserted that commerce with foreigners was the only means of augmenting the riches of a country without mines. The Physiocratists* wished to prove that agriculture was the only source of wealth; and there are many at the present day who exaggerate the importance of manufactures. But we must keep in mind that the value of any commodity whatsoever is exactly of the same kind as that which constitutes the value of gold and silver, because, by exchanging it, we can obtain the same articles that we could purchase with those metals; and we know that the value possessed by our invested wealth, whether land or moveables, may be the result of labour belonging to any of the classes above enumerated.

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* Francis Quesnoy, physician to Louis XV., was the founder of the physiocratic school. He attributed the depressed state of agriculture in his day to the mercantile system of Colbert, which favoured the industry of towns. His followers were Turgot, Le Trosne, and Schmalz. The fundamental principle was, that the earth is the only source of national wealth, and that only those who use or increase its natural powers and produce can increase that wealth. Agricultural labour was designated production, manufacturing industry sterile.

The several branches of human industry are differently pursued in different countries; but each, to a greater or less extent, is to be found in all. As civilization proceeds, each branch will receive more and more attention; and at this moment all the nations of Europe are endeavouring, with more or less success, to naturalize amongst them every kind of productive labour.

We have already shown that all the arts, whether physical, intellectual, or moral, and all the professions which have man himself for their subject, and aim to perfect his faculties, are on many points governed by the same economical rules as those arts which are employed on things. These form the department of what has been named immaterial industry. Such arts and professions are usually termed liberal, and they have been distinguished into—

The arts which are engaged with the preservation and perfectioning of man's physical frame; such as the art of the physician, the surgeon, the dentist, oculist, the arts of dancing, fencing, riding, &c.

The arts which cultivate the imagination and the affections; painting, sculpture, music, and poetry.

The arts which improve our intellectual faculties; logic, rhetoric, &c.

The arts which direct the formation of moral habits; government, religion, &c.

With the view of completing the round of human operations in industrial society, we may enumerate three principal actions which all persons, whatever may be the nature of their occupations, usually perform. Whatever commodities men produce, they are wont to associate—to exchange—to bequeath. They form societies in order either to produce better or to sell better. They can procure more aid in producing, and they have greater opportunities for exchanging, the commodities they produce for those which others produce. They bequeath to their kindred or friends the fruit of their own labour, or that which they have inherited from their fathers. In all well-planned treatises on political economy, considerations upon these three subjects ought to find a place.

BARRAN'S IMPROVED PISTON.

The modification of piston illustrated in the present article is by Mr. Joseph Barrans, of New Cross, near London, who has applied the arrangement in a locomotive engine, built by Messrs. Sharp of Manchester. Fig. 1 is a vertical section of the piston, as fitted to a locomotive engine cylinder; fig. 2 is a plan of the piston alone, with the top plate removed. The object of the contrivance is to save the time and trouble of taking down the buffer-beam, and the breaking of the cylinder-cover joint, as, by its adoption, the packing may be easily and quickly adjusted without involving the removal of any of the parts of the engine except two plugs in the cylinder-cover.

Fig. 1.

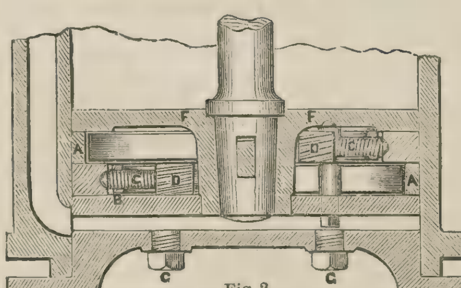
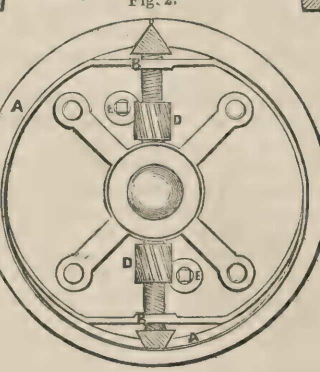


Fig. 2.



Scale 1-8th.

The drawings are almost clear enough to explain themselves. The two eccentric packing-rings, A A, of brass, are each acted upon by one of the circular springs flattened at the parts, B B, and tapped to receive the adjusting screws, C C, carrying expanding wedge-pieces of the ordinary kind. The inner ends of the screws are carried in bearings in the central eye of the piston, and are fitted with worms, or spiral pinions, D D, into which the corresponding spirals, E E, gear. The latter spirals are fixed upon studs, one end of which is rounded and fitted to revolve freely in the body of the piston at F F, whilst the other end projects through the loose plate of the piston, and is squared to fit a box-key, employed for the adjustment. Screwed plugs are fitted into the cylinder-cover at G G, corresponding in position to that of the adjusting studs, so that if, during a run, the driver finds his pistons are loose, he is enabled to set the packing out without any other trouble than the mere removal of the plugs for the admission of his key. This may be done in so short a time, that the entire adjustment may be readily effected in the time taken up by any ordinary stoppage at a station. Something of the same kind has been previously tried in stationary engines; but the idea of its application to locomotives, as well as the peculiar contrivance here adopted, is entirely due to Mr. Barrans.

SECOND REPORT OF EXPERIMENTAL INVESTIGATIONS ON COALS FOR THE STEAM NAVY.

Details of Experimental Trials.—Third Article.

Buddle's West Hartley.

This colliery is on the Low Main seam, nine miles from Newcastle-on-Tyne. Its depth is 360 feet where the vein is 5 feet 2 inches in thickness, and very regular, with a dip of 1 in 30 towards the south. The overlying and subjacent strata consist of argillaceous and siliceous deposits. The mine has been worked for the last eight years, and during that time specimens of the coal have been sent to nearly all parts of the world, to be employed for steam purposes, for which it is highly recommended.

The coal is worked by the "board and wall" system, gunpowder being sometimes employed to facilitate its extraction, and is described as "coarse and strong, free from clinker, and giving off but little smoke."

The present current price, loaded on the Tyne, is 8s. per ton; and the agent adds, that it is admitted in all the English and French government contracts.

The specimen examined by us was a hard resinous-looking splint, with numerous vegetable impressions in the joints of deposition, and a considerable amount of thin white shale in the cross-headings.

During the experiments it was found to burn freely, and blow off the steam rapidly, requiring but little trouble to maintain a good fire.

It was also observed to do better with a moderately quick than with a slow draught, and to evolve much smoke during the whole time of combustion.

Bate's West Haltley.

This coal is the produce of the High Main seam at the East Holywell colliery, which is situated in the parish of Earsdon, in the county of Northumberland, eight miles north-east of Newcastle-upon-Tyne. The mine is at present 42 fathoms in depth, and the seam varies from 5 feet to 5 feet 8 inches in thickness, with a dip of 1 in 16 towards the west. The coal is worked by the "board and pillar" system, as customary in that district. The shipping port, Newcastle, is at a distance of five miles from the mine, from whence about one-half its produce is exported to the various foreign markets, whilst the remainder is shipped for home consumption, and is chiefly employed for steam purposes.

The proprietors describe this as "a good steam coal, which has been found by local experience to excel most others," and state its current price to be 8s. per ton. The specimen which came into our hands was a hard splinty coal, with a cubical fracture, and consisted of alternate deposits of hard resinous coal and mineralized charcoal, the quantity of which was less than in many other varieties of the Hartley coal. It also contained large quantities of thin white shale, both in the planes of deposition and in the cross-headings. Frequent patches of iron pyrites were also observed.

During the experiments this coal was found to burn like the other Hartleys, giving off much smoke, and depositing large quantities of soot

Little ash or clinker was, however, produced by its combustion, and a good fire may be obtained without much attention on the part of the stoker being required.

HASWELL COALS.

This coal is raised at the Haswell colliery, six miles east of Durham, from the under part of the Hutton seam. The present depth of the mine is 936 feet. The total thickness of the Hutton seam is 5 feet 9 inches, with an underlie of 1 in 24, in an easterly direction. The overlying and subjacent strata consist of the ordinary shale and sandstones of the Newcastle coal formations, and the coal is described as well adapted for steam purposes, for which it is chiefly employed. The agent also states, that the Haswell Steam-boat Wallsend is harder than the Tyne or Weir Steam-coal, and that, from the circumstance of its being necessary to work the upper part of the Hutton seam before the lower portion or Steam-boat Wallsend can be extracted, the latter may be obtained in larger fragments than if it were worked alone.

These coals are chiefly exported to the various foreign markets, and may be shipped either from Sunderland, Hartlepool, or Seaham, from the two former of which ports the mine is situated at a distance of 9½ miles, whilst from the latter the distance is only 6. The present current price is 8s. per ton.

The specimen which was experimented on presented the same general appearance as the Hartley coals, with spots of white shale, vegetable impressions, and iron pyrites, although the latter does not appear to exist to any very considerable extent. The shale is, however, very abundant, and seems to be intimately mixed with the coal throughout its structure. This sample was also less brilliant than the generality of the Hartley coals, and contains a rather large quantity of mineralized charcoal.

Under the boiler this coal was found to light easily and burn freely, but did not blow off the steam very rapidly, as large quantities of white ash were produced, which speedily choked the fire and impeded the draught. Constant attention was, therefore, required on the part of the stoker, in order to keep up the steam. Much smoke was evolved during the experiments, though but little clinker was left on the bars.

DAVISON'S WEST HARTLEY.

This pit, which is 100 fathoms in depth, is worked on what is called the Low Main seam, one mile north-east of Bedlington, and three miles west of the port of Blyth. The seam is 5 feet 6 inches in thickness, and tolerably regular, with a dip of 1¼ inch per yard, 65° north of east. It is covered by 2 feet of blue shale, the other strata consisting of alternate layers of sandstone and schist. The coal is described by the agent as "very hard, easily ignited, and free burning, and leaving a white ash." The seam is worked by cutting out about a foot in thickness of its lower part, by means of picks, and then throwing down the upper portion by the use of wedges and mallets, gunpowder being sometimes employed to facilitate the operations. The coals are shipped at Blyth, where they are sold at 7s. 6d. per ton, delivered on board ship, and are from thence largely exported to the continental markets, for steam-boat purposes, and for the generation of steam in general.

In appearance this coal resembles the other good Hartleys, being hard and bright, with but little shaly matter or iron pyrites. Under the boiler it lights easily and burns freely, with the evolution of considerable quantities of smoke, and the formation of but little ash or clinker.

COWPEN AND SIDNEY HARTLEY.

This coal is the produce of the Cowpen colliery, in the township of Cowpen, parish of Woodhorn, county of Northumberland. This mine, like Davison's West Hartley, is on the Low Main seam, the pits being situated at a distance of 13 miles N.E. of Newcastle, half a mile from the seaport town of Blyth, and 11 miles north of the river Tyne; to the two latter of which places the coals are conveyed by rail for shipment to the home and foreign markets. The present current price is 7s. per ton. The seam is worked at the depth of 110 fathoms from the surface, has a regular thickness of 5 feet; and, being nearly horizontal, has no appreciable dip. The overlying and subjacent strata consist of various beds of shale and sandstone; and the manager describes the coal as "large, hard, and free burning, free from sulphur, and requiring but little stoking." He also adds, "it is highly prized for steam purposes, and that 600 tons are daily raised from the mine, which yields employment to 540 men and boys."

In appearance this coal resembles the Davison's Hartley, being a bright splint, with a cubical fracture, and contains but little iron pyrites. Under the boiler it was found to behave precisely like the preceding, although it does not burn quite so freely.

NIXON'S MERTHYR COALS.

This coal mine is situated on the Werra estate, near Merthyr-Tydvil, and is worked on what is called the Upper Four-feet Seam, which varies from 4 to 6 feet in thickness, and has an inclination or dip of about 1 in 10 towards the south. The roof of this vein is composed of sandstone and bituminous shale, whilst the bottom consists of fire-clay. The mine is worked by pillar and stall, and its present depth is 100 yards.

The shipping ports are Cardiff and Neath, from each of which towns the colliery is situated about 24 miles, and from whence the coals are exported to London, Liverpool, Southampton, France, Spain, and America. The current price of the Nixon's Merthyr is 10s. per ton, delivered on board ship; and it is described by the proprietor as "an open burning and nearly smokeless coal, little liable to deteriorate from exposure to the air."

The specimen examined at Putney College very closely resembled that from the Aberdare mines, except that it did not contain such large quantities of radiated semi-crystallized coal as the other varieties. Under the boiler this coal was found to light with difficulty, and to require a rather quick draught. It burns with a strong flame, and little or no smoke, leaving a considerable amount of ash, and but very little clinker. It is also liable to crumble on the fire, and fall through the bars; but, with a strong draught, it gives good results.

HILL'S PLYMOUTH WORKS STEAM COAL.

This coal is raised in the valley of the Taff, about three miles south of Merthyr-Tydvil, Glamorganshire. The seam is called the Four-feet Vein, but is generally about 6 feet 10 inches in thickness, and tolerably regular, with a dip towards the south. The overlying strata are composed of "cliff," and the subjacent of hard fire-clay. The mine is 112 yards deep, and is worked by stall and pillar.

The proprietors state that none of this coal has hitherto been sold, it having been exclusively employed for the manufacture of iron, for which purpose it is well adapted. It could, however, be brought to Cardiff, which is a distance of 21 miles from the mine, and sold at the ordinary price of coals shipped from that port, "say eight or nine shillings per ton," and as the vein exists under many hundreds of acres immediately contiguous to the spot from whence the specimen was taken, an indefinite supply may be obtained.

In appearance this coal differs from the last in being more granular in its structure, and containing no white shale in its cleavage. Mineralized charcoal was observed in small quantities, but not any iron pyrites.

Our experiments show that this coal does not light readily, and is rather bituminous, but when once a good fire is obtained, the steam is blown off steadily and rapidly, without the evolution of much smoke.

Like the preceding, it requires a strong draught, but does not contain so large an amount of incombustible matter.

STAVELEY COAL.

This is called the "Top Hard" coal of Derbyshire, and is mined in the parish of Staveley, 4 miles north-east of Chesterfield, in that county. The seam is perfectly regular, and six feet in thickness, with a dip of 1 in 8 towards the east. It is covered by hard clunch, or fire-clay, and lies on blue metal, locally called bind.

The coal is described by the proprietor as a "strong splint, which may be exposed for years to atmospheric influence without change or waste." He also adds, that the mine is worked by the "long wall" system, and that one foot of coal at the top of the seam is not worked out, but allowed to remain as a support to the overlying strata. The shipping ports are Gainsborough and Grimsby, from the former of which places the mine is distant 35, and from the latter 70 miles.

The coal is principally consumed in Derbyshire and Yorkshire, where it is used in the various stages of the iron manufacture, and is sold for 9s. per ton at the ports above named.

The specimen of this coal which was sent up for examination, arrived partly in casks and partly in bulk, the blocks varying from 1 to 10 cwt. in weight. In structure these masses resemble silicified wood, but seem to have two distinct planes of cleavage at right angles to each other, which give the fragments the form of long four-sided prisms, which, when broken, give rise to splinters having the same shape.

In colour this coal is not so brilliant as the Hartleys, but, like them, contains white shale and small quantities of iron pyrites in the lines of cleavage.

Its cohesive power is higher than that of any other coal yet tried by the officers of this investigation; and from this circumstance, added to the natural facility afforded by its form, the proprietor suggests that it might be sawn into blocks for the convenience of stowage in steamers.

When tried under the boiler, these coals were found to light easily and burn freely, blowing off the steam with great rapidity, and yielding much smoke.

It was also observed, that when a fresh charge was thrown on the fire, a crackling was heard, occasioned by the scintillation of the coals.

They require to be stoked like other splints, and burn to a white ash, which contains very little combustible matter.

Andrew's House, Tanfield.

The Andrew's House colliery is situated five miles south-west of Newcastle, in the parish of Tanfield, in the county of Durham, and is on the so-called main seam of that district, which is tolerably regular, and has a dip to the south-east. The overlying and subjacent strata consist of of sandstone and black metal, together with various seams of coal, some of which are workable. The mine is 38 fathoms in depth, and is worked by the "board and pillar" system. It is 24 miles from South Shields, from whence the coal is chiefly exported to London for the manufacture of gas and for coke-making, at the current price of 5s. 6d. per ton on board ship.

The specimen of this coal arrived in such small pieces that its physical characters could not be easily examined. It, however, appeared to be bright, and to have a cubical fracture, free from shale and iron pyrites.

On the fire, this coal agglomerates and chokes the draught, requiring much care in stoking, in order to keep up the steam, and appears much better adapted for coke-making than for steam purposes.

Experiments on the Relative Evaporative Power of the Tanfield Coke and the Coal from which it is manufactured.*

This coal is the produce of the Andrew's House colliery, and has been above described under that name. The coke experimented on was manufactured from the above-mentioned coal by the Messrs. Cory of New Barge House Wharf, and by them sent up in large columnar masses, having a silvery white appearance, and apparently free from shale and earthy impurities. The coal is converted into coke, in ovens of the usual construction, and yields, on an average, 65 per cent of coke of a good quality. In order to ascertain the actual quantity which this coal is capable of yielding, three experiments were made by putting a known weight in a small covered porcelain crucible, which being placed in an earthen one covered by charcoal in coarse powder, and again closed by an earthen stopper, was, in each case, exposed to a strong heat for an hour in an ordinary assaying furnace.

The charcoal dust, in this arrangement, protects the coal from the action of any unconsumed oxygen which may exist in the furnace. The following numbers were obtained from the experiments:—

	Weight of coal employed.	Weight of coke found.	Per Centage.
1st Experiment,	166·5	108·8	65·34
2d Experiment,	100·9	65·5	64·91
3d Experiment,	129·4	84·3	65·14
			3)195·39
Mean,			65·13

The above products, on being again strongly heated, sustained no further loss of weight, and a specimen of the coke experimented on, on being treated in the same way, was found to have lost but 0·2 per cent. of volatile matter; showing that but little loss had been sustained through the burning of fixed carbon, and that the process employed approached as nearly to perfection as can be hoped for in manufactures of this description.

It was found that one ton of this coal occupied 42·92 cubic feet, whilst the space required for the stowage of the same weight of coke is equal to 74·66 feet, giving a difference of 78 per cent. in favour of the coal. A great superiority in the evaporative power of a given bulk of this coal over the same amount of coke, also becomes evident on consulting the working tables, which show that one cubic foot of coal evaporated, during our experiments, 516·90 lbs. of water from 212°, whilst the same bulk of coke gave 237·30 as its evaporating power.

The experiments in this case were conducted in the usual way, except that the ordinary draught not being sufficiently strong to obtain a good fire with the coke employed, it was increased by blowing off the steam into the chimney by means of a tube fitted to the apparatus for that purpose.

Each experiment was also made to occupy 34 hours, in order to avoid the inconvenience attending the lighting of the coke, if more numerous trials of the ordinary duration had been made.

In testing the evaporative power of the coke, it was found necessary to employ 50 lbs. of Hill's Plymouth Works coal for lighting the fire, in addition to the usual quantity of wood used for that purpose. Allowance for these was therefore made in the calculations, estimating 9·75 as the mean evaporating power of the former, and 3·09 as that of the latter. The initial temperature of the water contained in the boiler was, in this experiment, 203°, and the steam was got up 1¼ hour after firing, thus showing that the action of the coke was slow at the commencement, even when aided by the addition of the coals employed.

During the progress of the trial, it was found necessary to heap the fuel more than was advisable for the economical consumption of the coke, as without doing so a sufficient mass of fire could not be obtained to keep up steady action; in order, however, to make the comparative trial as fair as possible, precisely the same method of stoking was adopted in the case of the coal.

At the close of the experiments it was found that 15·275 lbs. of water had been evaporated from 50° Faht., and 2184 lbs. of coke consumed, after deducting for that which remained on the grate at the close of the trial, which gives 7·91 lbs. of water evaporated from 212° for each pound of coke employed. The clinker formed was very fusible, adhering firmly to the bars, and choking the draught. The total quantity of residual matter amounted to 5·4 per cent. of the weight of coke consumed.

The experiment on the Tanfield coals was carried on precisely as the preceding, the steam blowing off into the chimney at an average pressure of 3 lbs., and the stoking conducted as in the case of the coke.

During this trial 9·91 lbs. of water were evaporated from 212° for each pound of coal consumed; and at the close of the experiments a larger amount of clinker was found adhering to the bars than in the former case, occasioned by the greater intensity of the heat produced.

The residual matters remaining after the experiments amounted to 4·5 per cent. of the coal employed, or 0·9 per cent. less than the quantity obtained from the coke.

This coal has an evaporative power of 20·1 per cent. greater than the same weight of coke manufactured from it; and if in each case a deduction is made for the incombustible matter contained in the fuel, the evaporating power of a unit of combustible matter in the coke is found to be 8·36, and that of the coal 10·39, or 19·3* per cent. more effective than a unit of the former.

The rapidity of action was also found to be in favour of the coal, as by it 526·3 lbs. of water were evaporated per hour; whilst the coke converted but 449·2 lbs. into steam in the same time. The consumption of coke per hour was 66·2 lbs., and that of the coal 62·3 lbs., showing a difference of 2·9 per cent. in the hourly expenditure of fuel. This coal loses 35 per cent. of its weight in the process of coking, and gains 11·7 per cent. in volume during that operation. It also appears to yield the most satisfactory results with a quick draught, as the experiments made with the steam blowing off into the chimney gave an evaporative power 5½ per cent. higher than the mean of the preceding trials.

Cannel Coals.

This coal is raised at Walthen House, two miles from Wigan. The present depth of the mine is 292 yards, where the seam is 2 feet 2 inches in thickness, with an inclination of from 1 in 15 to 1 in 20 towards the south, and is worked by the "board and wall" system. The subjacent and overlying strata consist of black stone and bass, which have the same inclination as the vein itself.

This coal has hitherto been exclusively employed for the manufacture of gas, with the exception of small quantities which are used for household purposes. The principal market is Liverpool, which is 33 miles distant from the mine, and to which place the coals are conveyed by the Leeds and Liverpool Canal, at a cost of 2s. 7¼d. per ton.

Large quantities are also consumed at Manchester, and the other manufacturing towns of Lancashire and Cheshire; besides which, a considerable amount is annually exported to France, Russia, and America. The current price of small coal at the pit is 10s. and of large 12s. per ton. In Liverpool the small is sold for 14s., and the large lumps for 18s. per ton. In appearance this resembles the ordinary cannel coals of the district, having a brownish black colour, with a resinous conchoidal fracture, and contains rather large quantities of iron pyrites and white shale.

Under the boiler it was found to light readily, and get up the steam very quickly, but to evolve large quantities of dense black smoke during the whole time of experiment, and at the close, left a large amount of cinder and red ash, together with a considerable weight of a very fusible clinker, which melted on the bars and obstructed the draught.

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* In the experiment here detailed, the coke yields a less evaporative result than the coal from which it is made. It must not, however, be supposed that this experiment is at all decisive with regard to this point in the abstract; it is merely true with reference to the boiler and conditions of draught under which it was tried. No conclusions can be deduced from it as to the still undecided question—whether coke is equal in evaporative power to the quantity of coal from which it is produced.

* Professor Johnson found the unit of combustible matter contained in the coke from Neff's Cumberland coal, to be 5·8 per cent. less effective than that of the coal itself. Vide *American Official Report on Coals*, p. 162.

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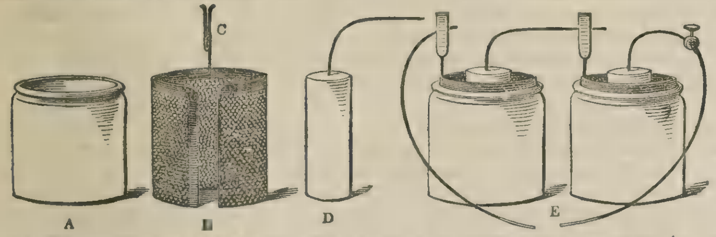
SMEE'S MECHANICAL PRINCIPLE APPLIED TO THE COMMON ZINC AND COPPER BATTERY, AS ALSO TO THE CONSTANT BATTERY OF PROFESSOR DANIELL.

By Charles Chalmers, Esq., Merchiston.

With a view to the application of Smee's mechanical principle to the common zinc and copper battery, I have employed cylinders of copper, perforated by means of a sharp-pointed instrument of five sides. Each puncture made by this instrument presents a projecting edge of five serratures, and each serrature has a ragged edge of minuter serratures. With upwards of three thousand punctures to each cylinder of copper, and with numerous points projecting from the ragged edge of each puncture, I find from experiment that I have obtained for the common zinc and copper battery the full benefit of Smee's mechanical principle.

The form of battery which I have adopted is much the same as that devised and described by Mr. Thomas Mason, in the "Annals of Electricity," vol. iii. p. 13, with this difference—I use zinc rods in place of cylindrical vessels of zinc, *punctured* in place of plain sheets of copper; and for connecting the cells into pairs, I have adopted cleft plates of brass, supported upon stout copper wires, instead of brass-cups, to contain mercury. Into these cleft plates of brass the wires from the zinc rods are pressed down, and are thus firmly grasped. This contrivance affords such facility in connecting into pairs the cells of a battery, that I can remove a zinc rod from a cell where local action has begun, and replace it by another newly amalgamated, in five seconds. In this way the local action of a battery may be almost entirely prevented, with little interruption to the flow of electricity.



A, Represents one of the cells of the battery, consisting of an earthenware vessel, 5 inches in height, and the same in width.

B, Represents a punctured sheet of copper, bent into a cylindrical form, which adjusts itself when placed in its cell by pressing against the sides of the vessel.

C, A cleft plate of brass, supported upon a stout copper wire, soldered to the upper edge of the copper cylinder.

D, A zinc rod, 5½ inches in height, and 1½ inch in diameter, having a copper wire soldered into the central part of its upper extremity.

E, Represents two cells in connection with the terminal wires of the battery attached.

I now proceeded to test the power of the common battery with *plain* cylinders of copper, and afterwards that of the common battery with the cylinders *punctured*. These two batteries were both put in action for the first time. They had each ten cells in connection, and were in every respect precisely similar, only the cylinders of the one were perforated, as I have described, and those of the other were made of plain sheets of copper. Both batteries were charged with a solution of sulphuric acid, consisting of one part acid and seven parts water.

EXPERIMENT FIRST.

Common battery, with *plain* cylinders of copper—ten cells in connection. The action of the battery continued for one hour—the terminal wires introduced into acidulated water.

Result.

Eighty-one cubic inches of the mixed gases came off in one hour.

EXPERIMENT SECOND.

Common battery, with *punctured* cylinders of copper—ten cells in connection. The action of the battery continued for one hour.

Result.

One hundred and thirty-five cubic inches of the mixed gases came off in one hour.

This battery, with punctured cylinders of copper, I have experimented with for several months. With a view to ascertain how much the power of the battery had diminished during that time, I selected from fifty cells ten of those copper cylinders which had the appearance of being most used.

EXPERIMENT THIRD.

Common zinc and copper battery—ten cells in connection. Cylinders *punctured*, having been in frequent use for several months. The action of the battery continued for one hour.

Result.

One hundred and fourteen cubic inches of the mixed gases came off in one hour.

When the two batteries, the one with plain, the other with punctured cylinders of copper, were put in action, with two liquids, as in the constant battery of Professor Daniell, the solution of the sulphate of copper being separated from the acid solution by means of diaphragms, consisting of cylinders of stout brown paper, I found the results as follows:—

EXPERIMENT FOURTH.

Daniell's battery—ten cells in connection, with *plain* cylinders of copper. The action continued for one hour.

Result.

Eighty cubic inches of the mixed gases came off in one hour.

EXPERIMENT FIFTH.

Daniell's battery—ten cells in connection, with *punctured* cylinders of copper. The action continued for one hour.

Result.

One hundred and eighty-six cubic inches of the mixed gases came off in one hour.

After having used this battery repeatedly in my experiments, I find that the serratures of the punctures seem to have become more pointed, arising, no doubt, from the precipitate of copper upon them. There may, however, be a limit to this, for after the battery has been used for several months, the copper may have been precipitated in such quantity as to deface the serrated appearance of the punctures, and thus impair the power of the battery. I should infer from these experiments, that the power of Grove's battery would be greatly increased by using punctured instead of plain cylinders, or plain plates of platina.

As a water battery, I find that two cells in connection with punctured cylinders of copper give off oxygen and hydrogen, though sparingly, when the terminal wires are introduced into acidulated water, a result which cannot be obtained when plain cylinders are employed with two cells in connection.

Although I have, at all times and in all circumstances, obtained a much greater quantity of the mixed gases from punctured than from plain cylinders of copper, I do not always obtain precisely the same results. Thus, when used as a Daniell's battery, I obtained, upon one occasion, three times the quantity of the mixed gases from punctured cylinders than was obtained from plain cylinders of copper; and, when used as a common zinc and copper battery, I obtained, upon another occasion, more than double the quantity of the mixed gases from punctured than from plain cylinders. This difference in the results may arise from a difference in the purity of the zinc or of the copper, or in the amalgamation of the zinc rods, or in the state of the weather, or from some other cause unknown.

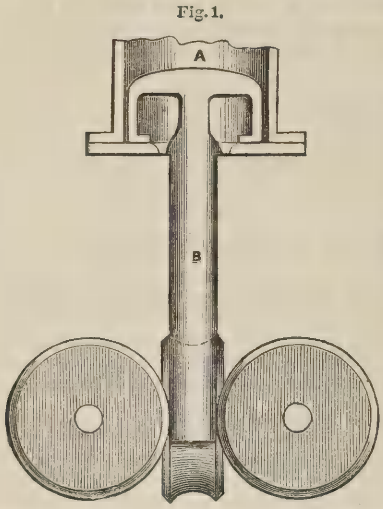
The battery which I have described may be used with facility, either as a Smee's battery, with one liquid, or with two liquids, as in the constant battery of Professor Daniell. I may add, that these batteries are powerful—not costly,* and very manageable.

RECENT PATENTS.

PIPES, TILES, AND BRICKS.—B. A. Burton, *London.—Enrolled December* 6, 1849.

The object of Mr. Burton's invention is the production of pipes and other articles from plastic materials, in such a manner as to insure greater strength, durability, and regularity of structure, as well as beauty of finish, than has hitherto been accomplished. The principle upon which he has worked is the compression of the material of the pipes by a process of rolling, which has been found to increase considerably the strength of the articles, as well as greatly to add to the smoothness and finish of the surface. The machine employed in the manufacture consists of a vertical frame-work, carrying two clay cylinders, so arranged that they may be alternately brought beneath the screw and piston, used for forcing out the clay through the dies, so that in this way, whilst one cylinder is in action, the other is being filled with a fresh supply of material. Fig. 1 is an elevation of the mandril and a pair of the rollers, shown in connection with the clay cylinder in section. Fig. 2 is a plan of the set of four rollers corresponding. The clay-holder, or cylinder, is represented as broken away at A, the die only being shown. The centre of the die carries one end of a mandril, B, which projects forwards, so as to terminate a little way past the centre line of the set of rollers, which embrace it. The rollers are carried in bearings in the cast-iron frame, C C, and they receive motion through a spur-wheel, D, on the shaft of the first roller, which communicates a simultaneous movement to the remaining three through the set of bevil wheels. The main driving-shaft of the machine, which drives the wheel, D, also actuates the screw bearing upon the clay-cylinder piston, employed for pressing out the clay through the die. As it issues from the die in the form of a cylinder or pipe, it slides along the fixed mandril, B, until the required length has exuded, when it is cut off in the usual manner, and the severed portion is afterwards drawn by the action of the rollers over the end of the mandril, during which movement the requisite compression of the substance of the pipe is obtained by the action of the four rollers combined, so that their contour at the point of junction forms a perfect circle upon the clay supported internally by the mandril.

Fig. 1.



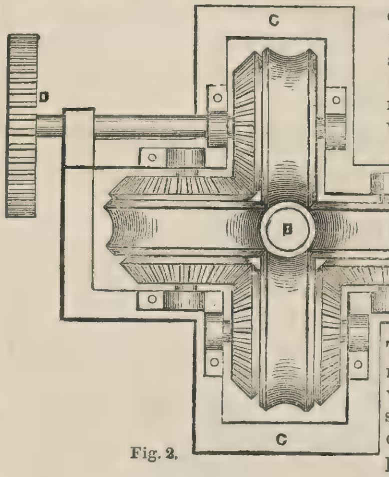
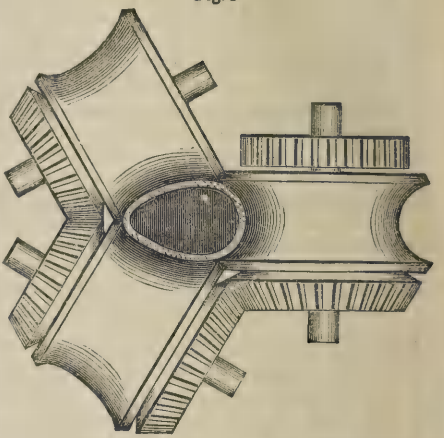


Fig. 2.

As delineated in our engraving, it will be seen that the pipes are compressed immediately after passing through the die; but the period of compression, as compared with the time of formation of the pipe, must depend, in some measure, upon the nature of the clay and the state of the weather, as in some cases it may be desirable to allow the newly-formed pipes to dry for a few days previous to the second operation.

The power of production of the rolling apparatus being much greater than that of a single die of the pipe-making machine, the patentee provides for the carrying on of the two processes in separate machines, so that a number of dies may be kept at work to supply a single rolling machine. He also gives several modifications of the mechanism for the production of other shapes than plain cylinders. Where taper-bored pipes are required, the mandril is made taper at the point, being gradually withdrawn during the passage of the pipe between the compressing rollers, and in lateral variations of shape, two, three, or more rollers may be used. Thus, for pipes of the egg-oval section, the arrangement given in fig. 3 elegantly fulfils the object, the three rollers being carried in a frame similar to that represented in fig. 2. In fig. 4, the same number of rollers is shown combined to form a step, or the rise and tread of a stair. In this case, the two rollers, A and B, may be engraved with an ornamental device, so as to impress the top and front side of the step.

Fig. 3



Hollow bricks or tiles are made on this principle, by forcing clay through a die of suitable form, the compression being accomplished by four rollers, two of which are turned of such a form as to produce a rebate on the edges of the brick, whilst the others carry a device for impression on the sides, the ends of the brick being subsequently rebated in a separate machine. Copings, columns, and similar articles, may be made thus; and, by the application of cams or eccentrics, various forms may be produced.

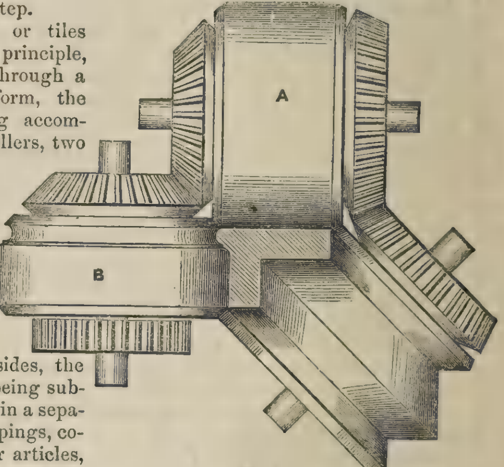


Fig. 4.

The patentee also describes a mode of making bent pipes, by so constructing the die that a bend of any required curve may be formed, simply by forcing the clay through it, moulds being thus dispensed with, whilst the compressing process is equally adapted to the bends as to the straight portions. As the result of the tests to which the pipes have been subjected, the patentee gives the following table of comparison with unrolled pipes:—

Bore of pipe in inches.	Thickness in inches.	Length in inches.	Weight in lbs.	Breaking weight in lbs. pressure per inch.	Rolled or Unrolled.	
2·812	·469	20·68	8·75	420	Rolled.	Fine Clay.
2·87	·471	22·37	9·25	380	do.	do.
2·87	·471	22·37	9·25	280	do.	do.
2·68	·472	21·	7·75	180	Unrolled.	do.
2·7	·473	21·5	7·89	170	do.	do.
2·69	·471	21·3	7·9	200	do.	do.
2·75	·468	21·5	8·12	140	Rolled.	Coarse Clay.
2·75	·468	22·31	8·25	270	do.	do.
2·75	·468	22·37	8·25	260	do.	do.
2·75	·5	21·37	8·25	160	Unrolled.	do.
2·75	·468	21·37	8·5	120	do.	do.
2·73	·475	21·47	8·36	110	do.	do.
2·375	·656	23·12	12·25	660	Rolled.	Fine Clay.
2·375	·656	22·75	12·25	360	do.	do.
2·375	·630	24·12	12·75	500	do.	do.

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* The individual employed to construct these batteries informs me that he can furnish a battery with ten cells for 25s.

The claims are—

First,—The application of rollers turned of such a form, and arranged in such a manner, that they may be employed for compressing the particles of matter composing pipes, tiles, bricks, copings, steps, pillars, columns, or other articles composed of plastic materials, intended for building, drainage, and other purposes.

Second,—The general arrangement and combination of parts, composing the machines for making and compressing pipes.

Third,—The mode of making bends for pipes.

Lastly,—The general arrangement and combination of parts, composing the machines for forming rebate or socket and screw joints.

PRESERVATION OF LIFE AND PROPERTY.—R. W. LAURIE, *Glasgow.—Enrolled January* 9, 1850.

The improvements secured under this patent comprehend no fewer than sixteen claims, embodying several ingenious contrivances and applications. The patentee describes, first, his modifications of mattresses, pillows, and bolsters, whereby these articles are rendered useful for the preservation of life from drowning, by the insertion into them of stuffed or inflatable tubes, and the formation of water-tight divisions. But the chief feature of novelty, in connection with the manufacture of buoys, is the use of any cheap close-textured material, in place of expensive waterproofed fabrics; for, as the patentee's experiments have shown, thick fabrics, as canvas or ticking, although not originally waterproof, invariably become so, when their substance is saturated with water; in fact, in some points, they are more valuable for the production of buoyant articles than the actually prepared materials, inasmuch as a slight perforation, which would be fatal in prepared cloth, has little or no effect upon them, for the reason that their elasticity quickly closes up the aperture. For the inflation of several divisions at once, when using a water-proofed material, Mr. Laurie employs what he terms a compound tubular valve, formed after the fashion of the piston-valve of the cornet. This valve admits either of a simultaneous or separate system of inflation, whilst each inflated cell is nevertheless kept detached from its neighbour.

He also shows two arrangements applicable for the prevention of shipwreck, in cases where danger is apprehended from driving ashore. One of these plans is on the principle of the fishing "otter," which, being hove overboard, gives the vessel a hold or pull upon the water, either by its direct surface pressure, or its inclined plane action. The other is a "water-sail," consisting of canvas distended on spars. This has somewhat the same effect as the "otter," and it is intended to take advantage of it, to obtain power for the propulsion of the ship, even against a wind, by the action of the sea currents.

Under another head is described a peculiar kind of rope, termed a "life-rope," which promises to be of some importance for use in ferry-boats, and on board ships and steamers. This rope is formed of cocoa-nut fibre, or some similar light material, covered with a waterproof fabric, or rendered waterproof by a wash with any suitable composition. When an end of this rope is thrown to a boat, or to a person in the water, it will float so as to render it an easy matter to lay hold of it. If used in a coil, it will of course form a complete and portable buoy. Perhaps the most important feature of the improvements is a new life-boat, which we have illustrated in figs. 1, 2, and 3, annexed. Figs. 1 and 2 are transverse midship sections of boats, showing two arrangements, or two combined arrangements, and fig. 3 is a plan. A series of floats or buoys, A A, are arranged along the sides and beneath the thwarts of the boat, and at the bow and stern, B B. One or more of the side-floats, as at C C, are loosely attached, either by a link, or set loose in a case or guide, as represented in our figure—the case being open at top and bottom to allow the water to enter. D, Is a tube for holding a quantity of shifting ballast, either in one mass or loose, as in the state of shot. So long as the boat is not upset, the ballast remains in a receptacle, E, formed at the end of the tube over the keel; but when the capsize takes place, this ballast falls over with the movement of the boat, taking the direction of the arrow, until it reaches the opposite closed end of the tube, on the side of the boat to which the loose floats are attached. The bottom of the boat then being upwards, as the set of floats are immersed, the loose ones traverse or rise upwards in the water to the extent of the movement which is allowed them, and this action causes their side of the boat to sink deeper than the opposite one, where the floats are fixed. This inequality of buoyancy is also increased by the action of the ballast in its fall to the lower side, and the combined action causes the boat to regain an upright keel. As a substitute for the moveable floats, the patentee proposes a clever contrivance, represented in figs. 2 and 3, in addition to the apparatus we have described. F and G, are two air-tight collapsable cases, placed one on each side of the boat, partially filled with air, and connected together by transverse tubes, H. When the boat capsizes, and one side is immersed deeply into the water by the action of the shifting ballast, the air-case on that side is compressed by the action of the water, so that the air in it is forced out of it along the tubes, H, into the opposite case, buoying up the opposite side sufficiently to cause the boat to right when assisted by the action of the ballast. Instead of placing the ballast so as to run to one side only, two or more ballast-chambers may be used, arranged to turn to opposite sides, with one set to allow its ballast to go either way, then the boat will right on either side, just as the preponderance of ballast is to one side or the other.

When the boat is turned over in such a manner that no air is collected beneath it, the elevating power of the buoyant apparatus tends to cause a vacuum beneath it, so as to suck in a body of water. To counteract this holding-down force, an air-valve, I, is placed in the bottom of the boat, arranged to be kept closed by a weight, or otherwise, so long as the boat floats on its keel; but when turned over, this valve opens and permits of a free admission of air to the interior. Another improvement refers to the use of waterproof paper, or other fabric, for envelopes for letters, either transparent, so as to admit of reading the address through it, or, if opaque, with an outside address written on or attached.

Fig. 1.

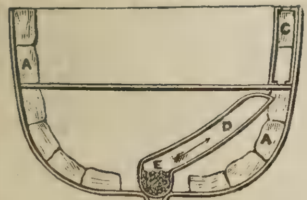


Fig. 2.

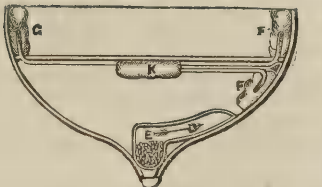
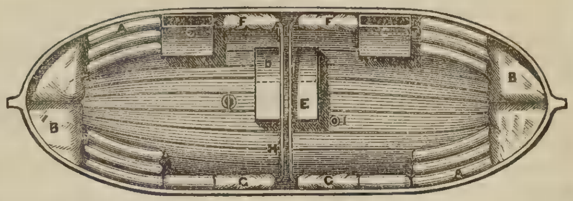


Fig. 3.



BREAD-MAKING.—G. A. ROBINSON, *Long Melford, and* R. E. LEE, *Glasgow.—Enrolled January* 10, 1850.

Biscuits have long been made by machinery, and why not bread? Messrs. Robinson and Lee's plans afford the best—in fact, the only practical answer to this query; for they have been the first to design and carry out a really practical arrangement as a substitute for the ordinary inefficient process.

The improvements secured under the present patent are—*first*, the use of carbonated or aerated water in the manufacture of the dough; *second*, an arrangement of machinery for mixing and preparing the dough, and moulding it into loaves; and, *third*, the direct application and use of surcharged steam as a baking heat. The use of aerated water produces a much finer bread than that made with yeast, and it will, besides, keep much longer. The machine employed for mixing, consists essentially of a kneading-mill, somewhat like the ordinary pug-mill, fed by a continuous supply of flour and liquid, the dough being forced out at the bottom in a stream, which is cut up into pieces of the size required by a self-acting knife. The pieces cut off are then moulded to the shape required by a very ingenious roller arrangement, ready for conveyance to the oven. A steam-boiler is built up along with the ovens, and a pipe from it passes through a coil placed in the furnace, by which means the steam is surcharged with heat, being in that state blown into the oven. We shall probably next month give some illustrations of the details of the machinery, meanwhile we append the claims:—

1. The application and use of carbonated or aerated water in the manufacture of bread.

2. The general construction and arrangement of the machine hereinbefore described, and its application to the manufacture of dough for bread.

3. The method or system of feeding or supplying to the machine flour or meal from the mass in a regular and continuous stream or discharge

4. The mode or means of assimilating, uniting, mixing, and kneading the materials used in the manufacture of bread and biscuit, in a constant

and uniform manner, as distinguished from the ordinary intermittent system.

5. The system or mode of giving out or delivering the dough for bread or biscuit of regular consistence, by a constant supply.

6. The system or mode of cutting off any desired portion of the stream or supply of dough, together with the peculiar apparatus hereinbefore described as employed for this purpose, and the arrangement or contrivance for altering or adjusting the length or rate of cut, and the consequent weight of the separated pieces.

7. The system or mode of moulding or forming the dough into shape for loaves, or forms in which the bread is to be made, together with the apparatus employed therein.

8. The application and use of surcharged steam for heating ovens, and for other like purposes; and,

9. The use or employment of the self-acting pyrometer, heat-regulator or governor, in regulating and indicating the heat of ovens, furnaces, and other heating apparatus.

CORRESPONDENCE.

INSTRUMENT FOR DRAWING EGG-OVALS.

I have taken the liberty of enclosing you a set of sketches of a little contrivance, which I have constructed for delineating the egg-oval. As far as I am aware, it is quite novel in its way, and I should be glad to see it in your pages, if you deem it of sufficient moment, as it may perhaps be found useful for the accurate production of the contours of vases and general ornamental work, and for a variety of purposes, for which ordinary drawing instruments are quite ineffective.

Fig. 1 is an elevation of the instrument as adjusted for drawing; and fig. 2 is a corresponding plan, showing the range of crank, and the size of oval for which it is set.

Fig. 1.

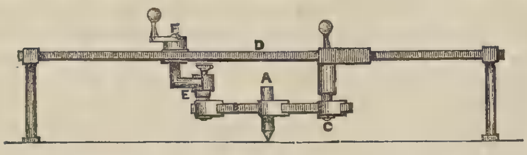
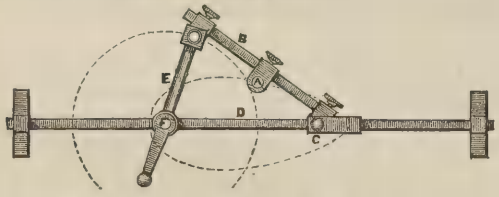


Fig. 2.



The pencil is at A, in an adjustable holder, capable of sliding along the connecting-rod, B, one end of which is jointed at C, to a slider on the horizontal bar, D, whilst the opposite end is similarly jointed to the crank arm, E, revolving on the fixed centre, F, on the bar. By altering the length of the crank, and the position of the pencil on the connecting-rod, the shape and size of the oval may be varied as required. Of course, the shorter the connecting-rod is made, the flatter will be the figure.

A Foreign Subscriber.

Kjorenhavn, January, 1850.

[This is a very neat instrument, and may be very serviceable in the way our correspondent mentions. It is, however, not entirely novel, although it is a better arrangement than any we at present remember. —Ed. P. M. Journal.]

DIFFICULTY IN THE WORKING OF STEAM SLIDE-VALVES.

I shall feel obliged, if, through the medium of your valuable Journal, I may acquaint Mr. B. S. Haworth with a means of overcoming the difficulty which he mentions having met with in connection with the working of the slide-valves of a pair of 12-horse engines.* Having had to overcome a similar obstacle in a pair of 50-horse marine engines, my plan of meeting the difficulty may perhaps meet his case.

The valves in question were taken out when the evil made its appearance, and were heated to a temperature equivalent to that of the steam working the engine, and the application of a straight-edge showed the faces to be out of truth, although they were quite fair when cold. The remedy then was, to scrape away the projecting portions, so as to reverse the condition of the faces when hot and cold—that is, to bring them to a true plane when hot. In this way, whatever theoretical injury may be done to the surfaces, considered in reference to their cold state, they will work well when under their proper steam pressure.

H. Equal, Engineer.

Mark Lane, London, January, 1850.

PRESS FOR DRYING PLANTS.

Perhaps a small press, as shown in the accompanying sketch, will supply the want of your correspondent, "Botanist," mentioned at page 233 of your last number. It consists simply of two flat hardwood boards, fig. 1, say 10 or 12 inches by 6 or 7 inches, and ½ or ⅝ inch thick, having corresponding holes at the ends of each to receive wooden screws, of the kind detailed separately, on a larger scale, in fig. 2.

Fig. 1.

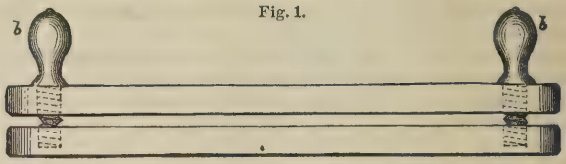
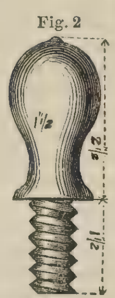


Fig. 2



The screws always remain screwed into the upper board, and the plant is laid between the leaves of some good absorbent blotting paper, which is laid on the bottom board, and when the screws are turned to enter it, the two are screwed up to the required tightness.

A few years ago, when studying botany for my own amusement, I got a small press of this kind made, of the above dimensions, in a remote village, by a wood-turner, and I found it to answer very well. All the parts can be easily taken asunder for packing in a portmanteau; and it would, in every respect, appear to answer the requirements of a "Botanist" as to "portability, smallness of bulk, and the power of readily increasing or diminishing the pressure." Ash was the timber I used for the boards and screws; but mahogany or boxwood would be neater, although no better

J. L.

Limerick, January 10, 1850.

APPOLD'S CENTRIFUGAL PUMP.

I have read in your last number an account of "Appold's Centrifugal Pump;" and as it appears to be so applicable to short lifts, as in draining, and particularly in building in tide-ways, I trust your readers will, on a future occasion, have the benefit of a general sketch, showing its mode of working, as well as the "full details," which you say you were not able to give in your last number.

Could any of your readers give us an account of the performance and working of the large chain pumps, which, I understand, are now much used in Scotland for discharging water at a high speed? The application of steam power is reported to have accomplished an amazingly quick discharge of water with this machine, on a large scale, at the Leith Docks, and elsewhere; and I have no doubt your English and Irish readers, of which latter I am one, would be glad to know the amount of its performance, and the particulars of its arrangement.

A Subscriber.

Limerick, January 14, 1850.

IMPROVEMENTS IN THE MANUFACTURE OF ALKALI, AMMONIA, COPPER, AND IRON.

The Manufacture of Alkali.

Since the repeal of the salt tax, the preparation of soda alkali has become an extensive and important branch of manufacture. In the form of crystallized soda, this is extensively used for washing and other domestic purposes; and in other states it is used for manufacturing soap and glass, and for bleaching.

To decompose salt, sulphuric acid is first formed, by burning sulphur and receiving the vapour, that is, sulphurous acid, with an addition of a portion of nitrous gas and water, or steam, in large leaden chambers, where the gases condense into liquid sulphuric acid, or oil of vitriol.

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* See page 206, for December last.

Salt is then acted upon by a due proportion of this acid in a reverberatory furnace; sulphate of soda forms, and muriatic acid is given off. This is extremely volatile, and difficult to condense; in consequence, some escapes into the atmosphere, causing considerable nuisance and damage around alkali works, notwithstanding innumerable contrivances for preventing it.

Sulphate of soda is again decomposed in another furnace, by small coal and carbonate of lime, as chalk or limestone. The coal abstracts the oxygen from the sulphate of soda; sulphuret of sodium forms; the mass then fuses, when the bases mutually exchange their combinations; lime becoming a sulphuret of calcium—the sodium a sub-carbonate of soda.

A mass of rough alkali, or black ash, is thus obtained, composed of soluble sub-carbonate of soda and insoluble sulphuret of calcium, which are separated by lixiviation with water. By the present improper mode of effecting this, the sulphuret of calcium is allowed to pass, partially, into a soluble hydro-sulphuret of lime, which renders the alkaline solution very impure, requiring to be purified before it is fit for use. The refuse, when turned out, becomes very offensive by heating, noxious gases being evolved.

Some important improvements in this manufacture are about to be proposed in connection with smelting copper, another branch of manufacture, which has hitherto been attended with much nuisance and damage.

Smelting Copper Ores.

The most abundant ores of copper are sulphurets. These are first calcined; sulphurous acid is formed, and in general is allowed to escape into the atmosphere. Iron is always present in these ores, and it becomes partially oxidised by calcination. In the second operation, a general mixture of ores is melted, the proto-sulphuret of iron acting as a flux. By some uncertain process, oxygen and sulphur pass off; the iron absorbs the sulphur from the copper, which settles to the bottom; the other ingredients form slag, which is skimmed off with a rake. This is a very awkward operation; if the workman dips too deep, he draws off copper; if he does not go deep enough, he leaves slag. The copper thus obtained is much impregnated with sulphur and other impurities, and requires to pass through a long series of operations before it becomes sufficiently pure.

Theory of the Formation of Ammonia.

While engaged in the alkali manufacture, I discovered that ammonia was formed by the action of vapour of water on the red-hot masses of rough alkali, the mixture of sub-carbonate of soda, sulphuret of calcium, and the remains of the coal, carbon. When one of these masses, just removed from the mould into which the fused material used to be drawn out of the furnace, was broken upon a moistened floor, ammonia was abundantly formed in the atmosphere above it. I made an attempt to apply this principle to produce ammonia in sufficient quantities to neutralise all the muriatic acid which we produced; but was unsuccessful. I was not, at that time, a perfect master of the theory upon which the formation of ammonia is based. I have since had great experience in the treatment of metallic sulphurets, the action of steam upon ignited carbon, and the effect of heat and combustion generally. I have determined, by results attained in such ways as to leave no room for doubt, that when sulphuret and carbon are acted upon by steam, at a temperature high enough to ignite the latter, say above 1000° Fahr., the oxygen and carbon unite into carbonic oxide, the hydrogen and sulphur into sulphureted hydrogen. These gases passing off at once into a cold atmosphere, the former absorbs oxygen, and forms carbonic acid, the latter absorbs nitrogen; a sulphuret of ammonia is first formed, which is again decomposed by the carbonic acid; carbonate of ammonia forms, and sulphur is deposited.

Proposed New Applications of Ammonia.

While I had it in contemplation to produce muriate of ammonia in such large quantities, I set on foot inquiries to determine to what new uses this salt could be applied. I ascertained that if sold at a cheap rate, that is, under £20 per ton, it would supply a great desideratum for washing sheep and wool, taking the oil out of woollen cloths, cleansing all greasy articles, as furs, skins, and hides, applied in this way:—The muriate of ammonia to be mixed with a sufficient proportion of lime, and confined in a close vessel having a pipe leading into water. A little heat applied will drive pure ammonia into the water, and thus a liquor of ammonia, of any requisite strength, could be readily produced for all of the above purposes. At the time I now refer to, guano had not been imported into this country. As the active agent in artificial manures, the consumption of muriate of ammonia may be said to be unlimited. My idea of using this salt as a fertilizer of land is, to allow some cheap abundant green crop to remain upon the land at the end of autumn, to be then ploughed in with lime, and the first dry weather in spring to sprinkle muriate of ammonia over it. The land would then be charged with all the elements of the purest stable or farm-yard manure.

Proposed Improvements in Smelting Copper.[*]

The fact cannot be disputed, that pure metallic iron has a stronger attraction for the majority of the bodies, with which copper is naturally associated in the different ores, than copper itself has; therefore, to produce copper by a single fusion, in a state of greater purity than it is now obtained after seven or eight operations, it is only necessary to mix with the ore a sufficient proportion of granulated iron to take up the sulphur, or other matter, in combination with the copper present: and further, by an improved arrangement of the furnace, a more complete separation of the copper and slag may be attained, while the latter is kept flowing off spontaneously. Pure iron in a granulated form may be prepared cheaply in various ways. The smelting of copper would thus be much simplified, and conducted without causing any nuisance or damage.

Manufacture of Sulphate of Ammonia.

In this mode of manufacturing, a large quantity of sulphuret of iron would be produced in the slag, which could easily be granulated while hot. By proper treatment, this can be made to yield ammonia and sulphur. An improved mode of converting sulphur into sulphuric acid, without using nitre, or leaden chambers, has been matured. Ammonia and sulphuric acid in vapour, drawn by a diffusion of steam into a condensing flue, or chamber, will yield a solution of sulphate of ammonia.

Proposed Improvements in the Manufacture of Alkali.

It is proposed to decompose salt in an open furnace by solution of sulphate of ammonia instead of sulphuric acid: sulphate of soda will be obtained as at present; muriate of ammonia will sublime; which being easily condensed, may be obtained as a solution, and crystallized.

The manufacture of alkali will thus be simplified also, and damage prevented. In lixiviating the rough alkali an improved plan has been matured, by the adoption of which the sulphuret of calcium will be preserved throughout. This being dried quickly at a high heat, and kept dry, will be valuable as a manure, more particularly for certain crops. A further nuisance will thus be avoided. This improvement in lixiviation, with a small addition of carbonate of ammonia to the liquor in boiling down, and an improved mode of evaporation, will produce soda alkali in a state of greater purity than it has hitherto been, which will lead to an extension of consumption.

Proposed Arrangements for Working Out the above Improvements.

The various subjects touched upon in the above remarks, would prove too multifarious and complicated for the consideration of parties to carry them out altogether in a single establishment. Such is not my object. By a proper division, the whole will be rendered simple and practicable. To smelt copper, the smelters must either prepare their own granulated iron, or have it done for them. The new furnace is extremely simple in its arrangements. The only novelty, therefore, requiring any nicety whatever, will be the granulating of the slag. The treatment of granulated copper slag to produce sulphate of ammonia will form a new branch of manufacture, requiring new establishments, and fresh people to embark in them. I would recommend, further, that the decomposition of salt should form a separate business, which could be advantageously conducted by parties engaged in salt works. The sale of muriate of ammonia would be a new and separate branch of business. Instead of purchasing salt, the alkali manufacturers would purchase sulphate of soda. Their operations would be much simplified; while they would have a new article, sulphuret of calcium, the preparation and storing of which would occupy their spare space. In addition to these, I must observe, that a quantity of iron will remain in the residue after the preparation of sulphate of ammonia, capable of being reduced.

The manufacture of iron, and its treatment to develop the several different properties requisite for the various uses to which it is to be applied, constitute altogether a subject of such magnitude and importance, that I shall defer its consideration for a future communication; in the meantime, my attention will be directed to the arrangement of abundance of data, which I have been accumulating for several years.

In preparing malleable or bar iron, attention should be directed to the use to which it is destined to be applied. That which constitutes excellence for one purpose, may be a defect for others. Thus, the fibrous texture, valuable in merchant bar-iron for a variety of purposes, is objectionable in iron to be used for railways, that being the great cause of lamination, crushing, and splitting, so much complained of.

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[*] These remarks do not comprise the entire application of the proposed principle.

To insure the two opposite forms of structure in iron, I have devised some improved modes of treatment:—First, by freeing pig-iron from earthy impurity, by puddling with the use of a blast, and by the addition of very pure carbonaceous matter, as peat charcoal, to produce merchant bar-iron from Scotch pigs, equal in quality to Russian or Swedish; secondly, by two very simple and economical arrangements, to convert melted metal from the blast furnace, or a cupola, into metallic iron, ready for drawing out into railway bars, the tyres and axles of railway carriage-wheels, sheets, &c., free from fibres, grains, or crystals, and dispensing with the refining, puddling, and re-heating, or ball-furnaces; and, thirdly, to adopt an intermediate course, and, acting upon an ordinary puddled ball, to drain off the more fusible portion of the cinder, and to convert the remainder into metallic iron, by the action of the gases produced from water and highly-ignited carbon—the iron to be drawn out into form without cooling, and the present customary routine of cutting up, piling, and re-heating.

T. H. Leighton.

Cross Inn, Llandilo, January, 1850.

WEALE'S DICTIONARY OF TERMS.

I have read with pleasure, in your January number, your review of Mr. Weale's "Rudimentary Dictionary of Terms," &c. Concurring in your remarks with regard to the paucity of engineering terms, I beg to suggest that this little work, in which I take an interest, might possibly be more extensively useful, if the engineering (mechanical), mining, and surveying terms were published in a separate volume from the fine art and architectural terms. With every respect for the *entente cordiale* between the architectural and engineering professions, I do not see why they necessarily must be joined together.

Practical.

Glasgow, January 14, 1850.

DAVIES' ROTATORY ENGINE.

In reading the account given by you of Davies' engine lately, in your Journal, I was led to believe the arrangement of a face, or set-up plate, was peculiar to Davies' engine; but, on turning up "The Glasgow Mechanic's Magazine," new edition, page 403, vol. v., I find Eve's specification includes an identical arrangement. He says—"As there is friction and wear at the two ends of the revolving cylinder, I have placed a false end;" remarking also, that "it can always be kept steam-tight merely by screwing up the false or set-up plate." Doubtless, Mr. Davies has many claims for our commendations in perfecting so much in the face of prejudices, that were even lavish in ridicule; but his friends only detract from his honour, if they attribute to his skill alone what has been the offspring of thought long ago.

Your opinion of the identity of the two schemes through your Journal, will oblige

A Mechanic.

[We have looked into the volume to which our correspondent has referred us, and although we find a "false end" mentioned (not, however, at the page given), yet there is nothing in the whole description which, in our opinion, detracts at all from the novelty of Mr. Davies' plan.—Ed. P. M. Journal.]

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

December 4, 1849.

Joshua Field, Esq., President, in the Chair.

The discussion was continued on Mr. Paton's description of the Southend Pier, and the ravages of the "Teredo Navalis," and other marine worms, and was extended to such a length as to preclude the reading of any original communication.

Numerous specimens were exhibited, and commented on, of timber thoroughly perforated by worms; whilst beside them, under the same circumstances, the "Jarrow wood," from Australia, was shown to have remained completely free from injury.

The reference to the age of Homer, as an instance of the ancient ravaging habits of the "Teredo," induced a return to geological questions; and it was shown that, in the London clay, remains had repeatedly been found of timber perforated by sea worms. The Oolite and Greensand formations also exhibited petrified wood, filled with boring Moluscæ. This led to the consideration of the formation most likely to withstand the attack of the "Pholas;" and it was shown, that the Portland stone was, from the quantity of silica it contained, least liable to be attacked.

The "Pholas" was shown to have been in active operation upon certain rocks from the earliest periods, but never upon Portland stone. Hence it was argued, that kind of stone should be used for breakwaters and other works exposed to the action of the sea.

The early state of the "Teredo" was noticed; when escaping from the egg, in the shape of a free swimmer, it was drifted about with the tide until it met with a log, a pile, or the side of a ship, to which it attached itself, and making an inroad into it, became a non-locomotive animal of different form and habits, never again to leave the habitation it had burrowed for itself in the body of the timber. The question, of whether the boring operation of the marine worms was carried on by chemical or by mechanical means, was lengthily discussed. The thin shell, covered by its delicate membrane, was instanced as not possessing strength enough to cut away timber; but it was on the other hand shown, that the shape of the two shells, forming the extremity of the animal, admirably adapted them for powerful cutting or rasping tools, when moved rapidly in a circular direction, as was evidently the case from the uniformly cylindrical character of the holes.

The shells of the "Pholas" were also shown to be used in that manner, and the opinion appeared generally to lean to a mechanical cause for the effects observed.

This bearing of the discussion naturally induced remarks upon the ravages of the white ant of India; which, however, appeared to have been little studied and less understood, as far as attempting to arrest or to prevent its inroads.

The various materials, such as Kyan's corrosive sublimate of mercury, Sir W. Burnett's chloride of zinc, Margary's salts of metals, Payne's combination of muriate of lime and sulphate of iron, forming in the timber an insoluble compound, and Bethell's creosote, or oil of coal tar, were discussed. All had their partisans, and were stated to have succeeded and failed under certain circumstances. Specimens of piles from Lowestoft harbour, whose waters were notoriously full of worm, showed that timber in a natural state was in a few months thoroughly perforated by "Teredo" in the centre, and "Limnoria" on the surface; but that piles, which had been properly saturated according to Bethell's system, in exhausted receivers, and subjected to such pressure as insured the absorption of about ten pounds' weight of the creosote, or oil of coal tar, by each cubic foot of the timber, were perfectly preserved from attacks of marine animals of any kind.

In one instance, a partially creosoted pile had a notch cut into it, deeper than the impregnation had extended; a "Teredo" made its entry, and was found to have worked in every direction, until it arrived within the reach of the creosote, when the animal turned away and eventually left the pile.

Bethell's system was admitted, by all the speakers, to be that which hitherto, after many years' experience, had afforded the most satisfactory results.

Some most conclusive experiments, instituted by Mr. Rendel at Southampton, were stated to have produced the same results; and at Leith all the piles were weighed before and after their saturation, to insure their absorbing the full allowance of at least ten pounds per cubic foot.

December 11, 1849.

"On the facilities for a ship canal communication between the Atlantic and Pacific Oceans, through the Isthmus of Panama," by Lieutenant-Colonel Lloyd.

In treating this subject, which, on account of recent events, has become one of great importance to the political and the mercantile world, the author brought to bear all the knowledge and experience acquired during a lengthened residence in South America, when serving in the Columbian Engineers, under General Bolivar, from whom, after much difficulty, he obtained permission to make the first survey of the isthmus, which he accomplished in the most complete manner, as well as making soundings throughout the principal rivers and in the chief harbours; compiling, at the same time, a mass of minute and valuable information relative to the country, which he transmitted to the Royal Society, in whose archives they were deposited, and a paper on the subject was published in the Philosophical Transactions in 1830. Thus may Great Britain claim not only the projection of one of the greatest works of modern ages, but also for one of her sons the merit of having, for the pure love of science, been the first to demonstrate the facility of the accomplishment of that which so many have since descanted upon, and, to some extent, appropriated without acknowledgment.

The general views of the author incline to the formation of a ship canal, in preference to a railroad. He denies that there are any obstacles to its accomplishment, but, on the contrary, asserts so many local advantages to exist and to be concentrated nearly at one point, that in after ages it will be a matter of wonder why so many generations should have neglected, or refused to render them available, towards the establishment of this long-coveted communication between the two oceans.

The paper first reviewed the surveys of Garella, of Morel, and others, who had examined the country subsequently to Colonel Lloyd. It then examined the various lines proposed, and gave reasons for preferring that which, starting from the beautiful bay of Limon, would proceed by a short canal, through a flat country, to the river Chagres, thence up the river Trinidad, as far as its depth would suit, and then cutting a canal into the Rio Grande, debouching at Panama. This line, it was contended, in the present state of the science of engineering, presented no obstacles, excepting the climate and the expense, to prevent a canal being cut of sufficient depth and dimensions to float, from one river to the other, the largest ship in her Majesty's navy.

The climate was stated, from personal experience, to be quite as good as in any tropical country, except in some particular spots, where, from local causes, certain complaints were rife.

The expense could only be accurately estimated by the survey of experienced engineers; but in a country abounding in fine timber, and the best building materials of all kinds, whilst no great chain of mountains, as had been fancifully depicted on suppositious charts, had any existence, except in the imagination of the designer, it was only fair to allow, that the cost of a canal of such limited length could not be very great, and the supply of water might be presumed to be ample in a climate where there was copious rain for nine months in each year.

The disadvantages of a railroad, in such a humid climate, were descanted upon at length, and it was shown that the risk of injury to merchandise from that cause alone, independent of that to be anticipated from breakage and pilfering during the various transhipments, must induce preference for a canal, through which vessels should pass from sea to sea without delay, and continue their voyage to their destination without breaking bulk.

The means of accomplishing the work were then fully considered. The proposition for a certain number of convicts, to be contributed by Great Britain, France, and America, was shown to be untenable; but it was argued, that a portion of the convicts from this country might be more advantageously sent there than to our present penal settlements. The means of preventing their escape were shown, and a proposition made for introducing with them a number of convicts from Bengal, and the other Presidencies, whose language and habits would effectually prevent their mingling with the British convicts, whilst their power of enduring fatigue under a tropical sun, and during rains, and their simple mode of living, would render them valuable pioneers for the more robust Englishmen.

It was stated, also, that a great deal of native labour might be obtained at a cheap rate; sixpence, or ninepence per day, and his rations, consisting of a pint of rice, a pound of dried beef, and a "golpe d'aguardiente," being the ordinary pay of a "peon."

The chief point, however, insisted on by the author, was the great field opened in the isthmus for emigration, for the surplus population of this country. He contended, that it was far preferable to the Canadas, where the poor but industrious and honest mechanic, or labourer, on arriving, found that the rich lands he had heard of could only be reached by a weary journey, and after such hardships, in a severe climate, as his limited means and broken strength rendered impossible for him to bear.

Australia, with its arid trackless wastes, held out still fewer temptations to the emigrant; for the ordeal of misery to be encountered by the majority was such as to deter all but the stoutest hearts from encountering it.

The isthmus had none of these disadvantages. It was comparatively within an easy distance; the emigrant would be at his destination almost on landing; the resources of the country were great, and the productions varied and cheap, whilst the present population was infinitely disproportioned to the superficial area of the country.

This point was strongly insisted on, and it was argued, that a grant of land might be easily obtained, in liquidation of the debt owing by the government of the country; and as the British had once possessed an establishment there, in 1675 to 1690, under the charter of the "Scotch Darien Company," so a footing being again obtained, a barrier of the most formidable character would be opposed to the annexation propensities of our transatlantic brethren, who were making rapid strides towards the possession of this valuable tract.

Appended to the paper was a copy of the commission granted to Lieutenant-Colonel Lloyd by General Bolivar, authorising his examination and survey of the isthmus and of the rivers, which had previously been most jealously refused to every one. This document was alluded to with some natural pride, as proving, that to an English engineer was due the merit of having been the first to examine and propose a work of such vital importance to the whole world, but which had been since claimed, and, in fact, appropriated, by other persons without acknowledgment.

December 18, 1849.

The Report of the Council, which was read, alluded to the past season of unexampled depression in the engineering world, but at the same time held out hopes of improvement, on account of the agitation of the subjects of better supplies of water and gas, the sewerage and drainage of towns, the construction of abattoirs, and other sanatory questions; whilst the improvement of canals, in their struggle with the railways for the heavy traffic, the construction and amelioration of harbours, the embanking and improving of rivers, the recovery of marsh-lands from the sea, and numerous other works, which had been neglected on account of the more attractive railways, would resume their former importance, and eventually afford ample employment for the majority of the members of the profession.

It was shown that the careful administration of the funds had been attended to, and that a considerable quantity of publications had been issued.

The alteration of the commencement of the Session was shown to have worked well; and, in general, the report of the progress of the Society was very satisfactory, in spite of the bad times for engineers.

The debt contracted for the improvement of the House of the Institution was stated to have been entirely liquidated, by the liberality of a number of the members.

Telford Medals were presented to Lieut.-Colonel Harry D. Jones, R. E., Mr. R. B. Dockray, and Mr. J. T. Harrison; Council Premiums of Books to Messrs. J. T. Harrison and J. Richardson; and Telford Premiums of Books to Messrs. R. B. Grantham, T. R. Crampton, W. Brown, and C. B. Mansfield; the President addressing a few complimentary expressions to each of these gentlemen on presenting the Premiums.

Memoirs were read of the following deceased members:—Messrs. J. Green, P. Rothwell, R. Sibley, and D. Wilson, members; A. Mitchell; Lieut.-Colonel A. W. Robe, R. E.; C. K. Sibley, W. Mitchell, and J. C. Prior, Associates; and J. Woods, Graduate.

The following extract from the memoir of Lieut.-Colonel A. W. Robe, will give a specimen of the manner in which Civil Engineers treat and speak of the memory of their deceased brethren, whether civil or military:—

"Lieut.-Colonel Alexander Watt Robe, R.E., was born at Woolwich, on the 31st of January, 1793; he commenced his military career, as a Gentleman Cadet, at Great Marlow, removing from thence to the Royal Military Academy at Woolwich, and obtained a commission in the corps of the Royal Engineers, in 1811; finally attaining the rank of Lieut.-Colonel in that distinguished corps, in 1837. By a remarkable combination of circumstances, although he was continually appointed for active service, his appearance was generally the harbinger of peace. He joined the army of the Pyrenees in 1813, just before the termination of the war in the Peninsula; and in 1814 was attached to the forces under Sir Edward Pakenham, in the expedition to New Orleans, but only arrived at the cessation of hostilities. Immediately on his return to England, he received orders to re-embark for the Netherlands, but only reached the seat of war a few days after the battle of Waterloo. He remained with the Army of Occupation until 1818, and shortly after his return was appointed to the Ordnance Trigonometrical Survey, the duties of which post he performed with great skill and ability until 1841, when he proceeded to Halifax, Nova Scotia, as Second in Command of the Royal Engineers; and in 1843 was appointed Commandant of the Royal Engineers at St. John's, Newfoundland, in which command his honourable and useful career terminated, with his valuable life, on the second of April, 1849, which was shortened by disease, originating in over-exertion on the survey in the North of Scotland, and aggravated by fatigue during the great fire at St. John's, where he toiled incessantly for forty-eight hours, in protecting the lives and property of the inhabitants.

"Colonel Robe was descended from a line of ancestors who had all been in the military and naval services; his four brothers were also distinguished officers, and two of them fell gloriously in the service of their country. He was devotedly attached to scientific pursuits, and was eminently useful in promoting the object of the Societies which he joined, and for this his mathematical acquirements and topographical knowledge peculiarly qualified him. He was elected an Associate of this Institution in 1838, and served on the council for some years with great zeal and attention, being continually present at the meetings, and inducing the frequent production of original papers, or presents of charts, &c., for the collection.

"In the performance of his military and civil duties, his zeal and ability were unbounded; as a son, a brother, and a friend, he could not be surpassed, and the public estimation in which he was held, was fully testified by the general mourning for his loss, at St. John's, Newfoundland, where he died, and where it was said of him, that 'it seldom fell to the lot of a military man to be so beloved by civilians.' The secret of this respect and esteem was the active and untiring benevolence of his character, which was only equalled by his unassuming manner, and the frankness and mildness of his demeanour; and the highest eulogium that can be paid is, that 'those who knew him best, esteemed him most.'"

The thanks of the Institution were voted unanimously to the President, Vice-President, Members, and Associates of Council, to the Auditors, Scrutineers, and the Secretary, for their attention to the interests of this Institution.

The President returned thanks very briefly, and on retiring from the chair, after holding it most worthily for the two past years, he recommended to the members his successor, Mr. Cubitt, whose active energy and high position in the profession, rendered him every way fit to occupy the chair of such a society.

SOCIETY OF ARTS.

November 14, 1849.

W. Tooke, Esq., F.R.S., Vice-President, in the Chair.

"On a New Principle of Suspension Bridges and Landing Piers," by Mr. H. H. Russell.

Mr. Russell commenced with some preliminary remarks on the origin and adoption of suspension bridges, which would appear to be of great antiquity, Humboldt, and other travellers, having seen them in uncivilised countries constructed of bark, reeds, and bamboo-cane, &c., slung across wide and dangerous chasms, and used for passenger traffic. In Thibet and China they have been found sufficiently strong to enable beasts of burden, and men with loads and palanquins, to pass over in safety. The application of this mode of constructing bridges in our country was first made by Captain Samuel Brown, R.N., in what he termed his "Chain Cable Bridges," and was first suggested to him by the rope-bridge of Penipe. Bridges of this description were constructed, and others proposed, by Telford, Mr. Tierney Clerk, and others. The success of these bridges gave so great a stimulus, as to cause their introduction into almost every civilised country in Europe; and their partial destruction has led to various arrangements for increasing their stability, especially with a view of arresting the undulations which may be excited in them. The principle adopted by Mr. Russell was first suggested to him by witnessing the rigidity of two lines of cobwebs crossing a street in the direction of the main-chains of the bridge; a third, running in a nearly horizontal direction underneath, was supported at intervals from the upper two in the one spandrail, and in the other had a circular web, of large dimensions, also stayed in all directions to the upper and lower webs; and a spider was observed to cross the lower cord without causing sensible deflection. The model and drawings exhibited were of a bridge with piers: the main-chains are arranged so as to pass over the top and under the bottom of the outer piers; thus presenting two systems of chains, having their extremities fastened at different points. By this arrangement the structure will, it is conceived, be more rigid, and the disturbance to which the bridge is subject less felt. The disturbances to which chain-bridges are subject are of two kinds—undulatory and oscillatory. The proposed plan prevents, it is conceived, the undulation, by relieving the summit of the piers from a great part of all strain, and throwing it upon their lower parts, where it is resisted by the roadway in the direction of the greatest strength. The oscillatory disturbances, or those from side to side, are considered to be practically annihilated by reason of the smaller curvature of the chains · and the more equal distribution of the load renders any local pressure less effective in causing disturbance; and additional facility is afforded for the introduction of stays between the chains, so as to equalise to a greater extent the tension and strength of the parts. The attachment of chains to the upper and lower points of the piers diminish, it is conceived, the tendency to general oscillation, while the alternation of long and short suspension-rods, and the steadying of the longer rods by passing between links of the lower chains, must almost entirely obviate local oscillation.

Mr. Russell is of opinion, that, by the mode suggested, a counteraction to any passing weight is obtained by the lower portion of the catenary curve, being supported on the pier through which it passes. The masonry above supporting the upper chain, acts so as to prevent deflection of the upper chain, unless the lower chain or pier should ascend, which is impossible, for the weight upon the suspension-rods is applied to both piers, thereby affording rigidity against action upwards.

November 21, 1849.

Thomas Webster, Esq., F.R.S., Vice-President, in the Chair.

Mr. Wass, the eminent engineer, has addressed the following letter on the subject of the death of the lamented Etty, to the secretary of the Society:—

"I doubt not but that most of the members of our Society will ere this have heard of the death of Mr. Etty, which took place at York, on the 13th inst., in the 63d year of his age. An incautious friend advised him to leave off wearing flannel, the throwing aside of which, in his delicate and long precarious state of health, added to, and brought on, an accumulation of disease, against which his already weakened frame gave way.

"It must ever be a most gratifying feature in the history of the Society of Arts, to all who took an interest in the exhibition of his works, and in the Fine Arts of this country, that the paintings of one of its brightest ornaments were selected *this* year. It being a regulation of the Society that only the works of *living* painters are to be exhibited, it would now have been too late; thus we should have lost one of the best opportunities of showing to the world the successful labours of a long life devoted to his art, and at his death encircled with a halo of glory, the closing scenes of a luminary which has now set for ever.

"I could not refrain from calling the attention of the meeting this evening more particularly to the subject, as it seems to me an opportunity for showing some little testimony of respect to the memory of one whose works so recently adorned the walls within which you are now assembled. To-morrow morning his remains will be conveyed to their final resting-place. His fellow-citizens are about to honour him with a public funeral, attended by the Mayor and Corporation of York, and everything outwardly to demonstrate their high estimation of his character and talent.—With best respects, I am, dear Sir, faithfully yours,

"Charles W. Wass."

A short notice of the life of the late Mr. Etty, R.A., taken from the Observer *of the 19th inst., accompanied the Letter, and the following Postscript was added by the Secretary*:

After the exhibition of his works at the Society, he immediately left London on a visit to Oxford; but, contrary to his original intention, he retained possession of his chambers in the Adelphi, with a view, as he stated, to having a home in London, where he might, for the few remaining years of his life, meet his brother artists during the season. At the end of one month he left Oxford, to take up his residence at his house in Coney Street, York; a house which he had, when a poor boy, looked up to as a home far beyond anything he could aspire to, and the possessor of which he had thought of as the great man of the city, but which house he had lately purchased. Here he expressed to his friends a hope that he might spend the remainder of his days quietly; not, however, in idleness, for he had long lent, and still intended to have continued, his assistance to the School of Design at York. After a residence of only a few weeks in his native place, he was taken ill; and, owing to an internal disorder and a combination of diseases, he expired after a short illness.

A supplementary paper "On Mr. H. H. Russell's principle for constructing Suspension Bridges," was read.

The Assistant-Secretary read a paper "On Flexible Breakwaters and Lighthouses," by Mr. W. H. Smith, C.E.

The paper, after alluding to the lives and amount of property annually sacrificed on our coasts—a loss which falls not on the shipowner or the underwriter, but upon the community at large—referred to various efforts that have been made by means of floating breakwaters to effect an economical barrier to the sea. These structures were subject to the following objections:

1. The danger of the isolated sections fouling each other.
2. Being adapted alone to shallow water.
3. Tendency to sink, from saturation of timbers, weight of chains, &c.
4. Want of access from one to another, or to the shore.
5. Their having no effect on the ground-swell.
6. Taut mooring.

The peculiar principle of Mr. Smith's proposed breakwater is to give elasticity to the structure. A model was exhibited, representing a long wall of open piling divided into separate sections of about fifty feet broad, each having an independent motion at the top, but secured and pivoted at the bottom on the screw-pile. The braces (with counterbalance weights in the centre) extending seawards from each side, are also affixed by the screw-pile or any other holdfast. The sections, on being struck by the sea, yield to it, thereby eluding its violence; and the wave, passing through the close grating, becomes disseminated. The structure recoils when it becomes in equilibrium with the wave, and on its return still further cuts it up. Excepting when under the influence of a storm, the breakwater is comparatively motionless. The author conceives it to be applicable to every situation for the formation of harbours. The material employed may be wood or metal. The same principle of giving elasticity to the structure is proposed to be applied to lighthouses, whatever the variation of circumstance, either as regards depth of water, situation, and peculiarity of bottom, from the hardest rock to the loosest quicksand,—the object proposed being to attain the greatest possible strength and the least possible shock from the force of the sea or wind-draft.

November 28 and December 5.

Mr. J. A. Leon "On the Cultivation and Manufacture of Sugar," in continuation.

The modern agricultural improvements, irrigation and subsoil drainage, are little known in most of the British colonies, and very few of the commonest agricultural implements have been introduced there. The chief alteration which has been adopted is the planting the canes at a greater distance from each other than formerly. The theory of clearing, planting, moulding, and cutting the cane in suitable season is understood, but seldom practised. It is erroneous to suppose that European labourers cannot endure the climate in the sugar-growing colonies, and European emigration ought to be encouraged. The first improvement in the West Indies should be the organization of a new system better adapted for emancipated negroes. The planter of the present day cannot do better than lease his fields to a set of negroes, on condition of their planting for him three-fourths of the land with sugar-canes; so that the negroes will be dependent for support on the produce and its quality, and will not fail to cultivate the land in a proper manner; the owner of the estate erecting improved steam-machinery, giving up the cultivation of the land, and remaining a sugar manufacturer. The ex-planter, in his new establishment, will then no longer require hired negroes, for the people of his manufactory being British emigrants, the colonial sugar will be produced by Creole growers and European manufacturers. Small West India proprietors should join their lands, so as to form a farm of 700 or 800 acres, to be cultivated as before mentioned, and erect thereon a central sugar manufactory capable of working the produce from 500 acres of sugar-canes, which will be, on an average, 1000 tons of Muscovado sugar from 10,000 tons of canes. Thus they would farm in a small space, and manufacture with powerful machinery, in which consists the required agricultural improvements, and isolated estates might send their concentrated saccharine matter, or crude sugar, to a parochial central factory.

The cultivation of the sugar-cane requires more labour than other plants, and in that respect a cane field may be compared to a garden, and, like it, requires constant care and attention.

The woody part of the ripe sugar-canes is generally consumed as fuel in the process of manufacturing sugar; other portions are used as seed, forage, and manure, the green leaves being given as food to cattle. It is found that 100 lbs. of canes generally yield 50 lbs. of juice; these 50 lbs. of juice produce, by the old process of manufacture, 5 lbs. of Muscovado sugar, and 5 lbs. of molasses scum; the remainder, 40 lbs., is the quantity of water to be evaporated by the manufacturing process.

Nothing can surpass the slovenly, unscientific way in which sugar is made on those estates where the common process is in use; and in the whole British dominions only four sugar plantations have received complete steam-machinery. The author recommends steam, not only as a moving power, but also for heating and evaporating purposes, and refers to a colonial steam-generator, which he has invented, as answering every purpose that can be required; but this modern apparatus will be only beneficial when worked on a large scale.

In selecting the ground on which a manufactory is to be erected, mainly depends its future success.

The essay then describes the various existing mills made use of in the manufacture of sugar, of which the chief defects are—

1. Overspeed in motion.
2. Mismanagement in feeding.
3. Inefficiency of the moving power.

The great price of coal, however, in the West Indies, being £2. 18s. per ton (when used), renders the working of steam power very expensive; however, the steam may be economised, and employed in subsequent processes.

The essay proceeds to describe the steam-defecator, and other apparatus employed in the manufacture of sugar, and the advantages peculiar to each.

A great improvement in sugar manipulations, even greater than the concentration *in vacuo*, is the application of animal charcoal for manufacturing and refining sugar. The discovery of revivification allowing the same carbon to be used again, enables the refiner to produce the best quality of sugar from the raw material by a single operation; *and by improving* on the same principle of filtration, the colonial manufacturer will succeed in producing refined sugar direct from the cane, and thereby dispense with the secondary manipulation in Europe.

Concentrated cane-juice, containing more than 50 per cent. of saccharine matter, will be altered if boiled at a high temperature, or re-concentrated at a low one; but if boiled *in vacuo*, the saccharine liquid may be rapidly concentrated at even a low temperature. The author recommends the use of Clark's condenser, in which the steam is distributed all at once, in 216 vertical pipes, radiating to a single collecting pipe, communicating with the air-pump,—and a double-evaporation apparatus constructed by himself, and operating—

1st. Without altering the saccharine matter, as well with a minimum as a maximum of water.

2d. Without borrowing any water.

3d. Without requiring active superintendence, and saving fuel to a large amount.

In building a sugar manufactory, the main flue of the steam-generators should pass close to the curing-house wall before reaching the chimney—cast-iron tubes lying across the flue, having one end in the curing-house, whilst the other receives the outside air, being heated from the caloric from the furnace, warms the inner air passing from the yard into the curing-house. Thus a hot-air apparatus is formed with great economy. The direct bleaching, *i.e.*, the artificial mode for separating the liquid from the solid sugar, is done by sprinkling water on the sugar with a small instrument made for that purpose, and, according to the number of ablutions, this operation will produce crushed lumps, or stamped loaf-sugar.

The modern steam apparatus for manufacturing sugar with profit requires the fulfilment of several conditions:

During crop-time, continuous work night and day; from whence three advantages arise.

1st. The cane-juice does not become sour, as when left standing during the whole night in the heated apparatus.

2d. Fuel is saved, because the fire has not to be re-lit.

3d. Double work being done, the expenses of the machinery are reduced 50 per cent.

A better class of labourers must be procured, and work for the whole year round provided for them.

Mr. Leon is of opinion that nothing but such a total change can restore the British sugar colonies; and to prepare for this, two things are necessary:

1st. A thorough knowledge of the modern art of building, erecting, and working the improved apparatus.

2d. Regular theoretical and practical information on sugar manipulation for the instruction of colonial factory managers, to be given in a London laboratory, furnished with the necessary utensils for working on a small scale. The sugar for experiment should be extracted from the beet-root, the juice of which is nearly identical with that of the sugar-cane.

DECEMBER 12.

"On the application of Electricity to the Arts and Sciences," by Mr. E. Highton, C.E.—Mr. Highton commenced by alluding to the many technical terms with which the science is encumbered, tending to retard the progress of the student. The principal means hitherto used for developing the power were stated to be the following: friction, chemical action, caloric, muscular power, and the relative position of bodies under peculiar conditions.

The connection between electricity and magnetism was then briefly explained, and the peculiar phenomena of magnetic and diamagnetic bodies pointed out—the author stating, that all bodies have been found capable of assuming either the magnetic or diamagnetic state. The principal results produced by the action of electricity are thus enumerated:

1. Causing matter to assume certain definite positions.
2. The production of an attractive power.
3. " " of a repulsive power.
4. " " of positive or negative caloric.
5. " " of light.
6. " " of sound.
7. Chemical composition or decomposition.

In short, the production, more or less, of all the other forces of nature.

The author then proceeded to point out the applications of electricity, briefly alluding to the electric telegraph, on which subject he had read a paper to the Society in the last session. He next pointed out various processes of electrotyping, the most recent of which was the copying of Daguerreotype pictures, specimens of which were exhibited; the delineation of architectural buildings; the making transfers from engraved plates; and also of engraving steel-plates by means of a current of electricity from a platinum point. The process of electrotyping, as applied by Captain Ibbetson to the preservation of the form of natural objects, such as animals, insects, plants, &c. Specimens of fishes, frogs, butterflies, spiders, leaves, and flowers of the most delicate structure, were exhibited. A model of the Isle of Wight, from an electrotype mould, was also exhibited.

The application of electricity for measuring the velocity of bodies in their transit through space, in small periods of time, was alluded to; and an instrument for the purpose, invented by Professor Wheatstone, was exhibited and explained. The action of it is as follows: An arrangement of mechanism allows a current of electricity to act upon an electro-magnet during the passage of the body from one point to another. The electro-magnet is attached to a train of wheels, connected with a dial, the hands of which revolve at such a rate as to point out the 1000th part, or any other division of a second. The current of electricity, being allowed to act on the electro-magnet only during the passage of the body, permits the hands to progress only during such transit, and thus the time occupied is shown on the dial.

The experiments on falling bodies made by Professor Eisenlohr with this instrument were noticed.

The author then alluded to the application of electricity for ascertaining the temperature of water at great depths in the ocean; also for denoting a variation of temperature, to the extent of the 100th part of a degree, by means of thermo-electricity; the telegraphing of time at two stations, for ascertaining their difference of longitude; and its great value for blasting purposes.

He then alluded to electric clocks, and the latest improvements in their construction.

The application of electricity for printing on porcelain, the formation of lightning conductors, illumination, motive power, and medical purposes, were severally discussed.

The latter portion of the paper consisted of various suggestions for new modes of applying the power of electricity: one of which was the application to the art of war; another for testing the quality of air in coal mines. Allusion was then made to its probable application, at no far distant date, to the manufacture of ice for domestic purposes.

The several theories of the formation of hail were explained, including those of Professor Muller, Volta, and Prout, &c., and a new theory suggested by the author was described.

The author concluded with remarks on the application of the peculiar property of electricity in the production of direct circular motion, thus affording a valuable analytical test for the other forces in nature, and entered fully into the application of this test to the motions of the heavenly bodies.

DECEMBER 19.

Mr. Highton concluded a paper "On the practical application of Electricity to the Arts."—Mr. Hunt, and several other members, addressed the meeting. In the course of the evening, it was stated that Mr. Elkington had discovered a means of depositing, by an electrotype process, silver of such hardness as to resist the action of a file, and that Captain Ibbetson was engaged in electrotyping a spider's web. Several large and minute solid specimens of electrotype, in the precious metals, and *in brass*, were exhibited; among which we noticed two in copper, bronzed, from the laboratory of Mr. Henry Elkington, the one of the celebrated Bacchanalian vase in the British Museum, and the other of a head in the Vatican. Others were shown, in copper, of copper-plate engravings, insects, flowers, macerated leaves of plants, and Daguerreotype plates. A very beautiful salver of silver, relieved in gold, produced by the same process, was also on the table; the mode of production being stated to be, by first depositing a whole silver surface, and then filling up, with a composition of shell-lac and naphtha, the portions not intended to be covered with gold, and submitting the object to a gold electrotype process.

Mr. Barrett afterwards read a paper "On an Improved Method of constructing Buildings, whereby they are rendered Fire-proof, without increase of Cost."—The vast amount of property annually destroyed by fire has occasioned public attention to be directed to the importance of having buildings constructed upon fire-proof principles. However, the general introduction of the system has been prevented by the prevailing idea of an increase of expense; but the author conceives that, by the proposed mode of construction, buildings proof against fire and dry-rot, and of superior strength and durability, may be constructed at the same cost as buildings not fire-proof.

The leading features of the proposed improvement are, the substitution of joists of wrought or cast-iron for those of timber; employment of successive layers of incombustible materials, supported by these joists, for the floor or roof. The author conceives that, by this method, great development of strength and firmness may be gained by the combination and consolidation of the materials into a complete mass. The joists are submitted to a test of 75 lbs. to 150 lbs. per square foot of flooring, $\frac{1}{3}$d of their breaking weight; but increase of strength derived from the combination renders a floor capable of sustaining two or three times that weight. The joists are of a T shape reversed. The upper surface of the web is of a curved form, and the bottom flange is either quite level or slightly cambered. The flange serves as a support for the strips and superincumbent layers of incombustible materials. The joists are placed about 18 inches apart for floors, and 24 inches for roofs, and have a bearing of about eight inches in each wall, with dove-tailed ends. In the construction of these floors and roofs the short strips or lathes, bearing on the flanges of the joists, may be made of any material, and a coat of coarse mortar must be spread upon, and pressed down between, the strips, for the support of the ceiling lathes; and upon this a layer of concrete or pugging, formed of any material at hand, five inches thick for the floors of dwelling-houses, and nine inches for warehouses. In forming concrete for roofs, it is desirable to use hydraulic lime, in proportion of 6 or 7 to 1, so as to have a water-tight foundation for the finishing coat of the roof. Thus a fire-proof foundation is obtained, upon which a floor or roof of any kind may be laid. It is preferable that the finishing coat for the floors be made of lime, sand, and ochre, with two coats of linseed-oil, applied by a brush; and that for the roof of Portland cement and sand.

The first house erected on this principle, sixteen years ago, by Dr. Fox, was Northlands, near Bristol.

The principal advantages in the proposed method of constructing the floors, ceilings, and roofs of buildings, may be thus stated:—They will be fire-proof in every room; economical, comfortable, and cleanly; perfectly dry and hard; impervious to smell or sound; admitting of the best plans for warming and ventilating; proof against damp. The carpets are found to last longer. The roofs, being water-proof, are a greater protection against the weather; and the materials used being non-conductors, the rooms immediately beneath are not liable to those extremes of temperature which, during the heat of summer and the cold of winter, render the upper rooms in houses of the ordinary construction almost uninhabitable. Charges for repairs are reduced to a mere fraction, and insurance against fire is unnecessary; no tie-rods are required, there being an absence of all lateral thrust. The floors, from their arrangement, protect the joists from any concussion produced by the fall of a heavy weight. The method proposed affords a ready and inexpensive means of complying with the requirements of the Metropolitan Building Act. The author states that the proposed system can be carried out at a cost not greater than the ordinary mode of building, and gives, as the cost of the floor of a room 20 feet square, on the fire-proof plan, £20 16s.; timber floor, with sound boarding, &c., on the old principle, £30 8s. 10d.

GLASGOW PHILOSOPHICAL SOCIETY.

November 29, 1849.

"On Piassava, a Substitute for Bristles."

Dr. Walker Arnott brought under the notice of the Society a substance which has been lately imported into Glasgow, under the name of Piassava, or Piaçaba, but which, from its being unknown in the market, had to be again shipped for London, where, as well as in Manchester, it is well known as a substitute for bristles or whalebone for brushes and street besoms,* besides being applied to many other purposes for which it is fitted, by the great length, elasticity, and strength of its fibre, as well as its capability of resisting the action of damp. In Brazil, it is made into strong ropes for ships and draw-wells, and is exported chiefly from Bahia. Dr. Arnott mentioned that it was obtained from the palm called now Attalea funifera by authors; and the portion used is understood to be the spatha, and the dilated base of the leaf-stalks, which latter splits into shreds, and hangs like a veil from the tree. The nut of this palm is figured by Gaertner, and was formerly known under the name of Cocos lapidea, and is imported under various names from Bahia and Brazil, for the purpose of being turned into umbrella handles, ink bottles, and other ornamental articles; but the importers of the nut seem to have no idea of its relation to the Piaçaba palm. [A reduced coloured figure of this palm has been published in Hooker's Journal of Botany and Kew Miscellany, for April, 1849.]

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE—NINETEENTH MEETING.—Birmingham, Sept. 12, 1849.

Section A.—Mathematical and Physical Science.

"Report on recent Applications of the Wave Principle to the Practical Construction of Steam Vessels," by Mr. J. Scott Russell.—During the last year I have had more than one opportunity of applying the wave principle to the construction of steam vessels. There is one case, however, in which I have been able to apply it to practice under circumstances of greater complexity and difficulty than have ever occurred to me, and where it has been successful in overcoming difficulties to a greater extent, and in a more decided manner, than heretofore. During the last year a very difficult problem was proposed to me. It was this:—to build a steam vessel that should be fast without great length, a good sea-boat without drawing much water, and to carry a great top weight and yet swim very light. Besides, this vessel was to be able to go backwards as well as forwards equally well; and, though a small boat, was to contain great accommodation. The problem is one to which the wave principle is far from seeming peculiarly applicable. In the first place, it is well known that the wave principle prescribes a different form of the bow from that of the stern, in order to obtain most speed with least cost of power. In the second place, it is known that a high speed requires on the wave system a very considerably greater length than was here allowed for the entrance of the vessel or the lines of the bow. It would therefore seem at first to be a case that would prove too difficult for the successful application of the wave system. There is one more feature in the case which gives it interest. At the same time the same problem was worked out by another party on another plan of construction, *not* on the wave principle. Another vessel was built under similar conditions, and furnished with engines of the best construction, made by one of the most eminent engineers in England. Both these vessels were built at the same time, and tried under similar circumstances; therefore, here was a case in which the practical value of the wave principle has been brought to a test more direct and less questionable than any that was likely to have occurred—and, therefore, more important to be placed on the records of the British Association. The first question which will naturally occur to a member of this Association who recollects this principle will be this:—How could you apply the wave principle in a vessel made to go equally well both ways? The first answer is ready—it is this, that the vessel cannot be made to go so fast as if designed with equal power to go only one way—seeing that in one case she would have a best possible bow and a best possible stern, and in the other case could have neither. The next point is this, that in both cases of bow and stern it was necessary to have a compromise. Each required to be in turn bow and stern. This was accomplished in the following manner:—If there be any point which has more forcibly struck me in the application of the wave principle than another, it is the flexibility of the wave principle,—the extent to which it admits of deviations from its strict rules without losing the benefit of its assistance. If it had unluckily been true of this system, that it prescribed an exact mathematical solid in its three dimensions (like Newton's Solid of least Resistance), to which implicit adherence was imperative on pain of losing all the benefit proffered, then, indeed, the system would have been (like Newton's) of little use, from the fact that, from causes independent of resistance, ships cannot be solids of revolution, consistently with other qualities. The wave principle, on the contrary, possesses wonderful flexibility; first, from the circumstance of its prescribing lines *in one plane* only, and so leaving the other two dimensions in the hands of the practical constructor,—so that the sections of the vessel in one plane being given by the system, the sections in two others are at the service of the constructor. I had in this case to lay down for both ends of the vessel, that which is best for a bow, and that which is best for a stern, at the given velocity. I had next to place relative values on bow resistance and stern resistance. I had next to single out from between those two lines one which, taken either as bow or stern, would deviate least from either, and so have least resistance on a mean of both directions. This, therefore, the wave principle did: it gave the limits, and gave also the choice of a series of means all more or less suited to the purpose intended. I have now shortly to state the practical details by which this process was carried into effect, and the results arrived at in consequence. The engines of the vessel, as well as the vessel, had to be constructed by my partner, Mr. A. Robinson, and myself, and we were enabled to adapt the one to the other with greater ease and certainty than in all likelihood we could have done had the engineer been separate from the shipbuilder. In our case the engine was considered and made an actual portion of the ship, and the ship of the engine. It will be fair, therefore, to deduct from the good effects attributed to the wave form of the ship such advantages as we possessed in building both engines and boilers and ship as one whole;—still it is fair to remember, on the other side, that the builders of the engines with which ours had to compete, have been celebrated for their efficiency, and for the large actual power they have developed, when compared with their nominal power. It should also be remembered that the builders opposed to us had previously built the fastest boats of their district. The results obtained are as follow:—Both vessels were about 150-55 feet long; 22-22½ feet beam; 4 feet draft of water; 240 tons displacement; 150 horse-power, nominal; propelled by oscillating cylinders of 48 inches diameter, with the same proportion of stroke to paddle-wheel in both cases; and with only such differences as the engineers and shipbuilders in each case considered likely to be most successful in carrying out the execution of their work to the best advantage,—the terms prescribed to both builders by the engineer of the proprietors being identical, and with only such latitude as should not form an obstacle to whatever might seem best suited for obtaining greatest efficiency.

Results of Experiments on Velocity with equal Power.

	Wave vessel.	Competing vessel.	
Speed	16·13	15·03	miles per hour.
Power	20·3	19·9	velocity of wheel.
Loss	4·17	4·87	slip of wheel.

These are the results of accurate trials, at the measured mile, made both with the tide and against it. It is important to observe the amount of slip, as it serves to show that it was no deficiency of the engine power which caused the difference, both engines having gone at, as nearly as possible, the same speed. In order that the statement just given may not lead to false conclusions, it is necessary to state what were those minor differences in vessel and engine which each constructor adopted as tending to greater efficiency. The wave vessel had a flatter floor, and considerably squarer on the midship section, which was done for diminishing the depth of water as wanted for her use. In the other vessel, the consideration of draft of water was rejected or overlooked, and a finer midship section taken, although with a larger draft of water. In one case, also, the rudders were considered as part of the length of the vessel, and treated accordingly, and in the other case rejected from it. In the engines, also, although the diameters of the cylinders were identical, the stroke of the wave vessel was somewhat longer than the other, but the diminished effective diameter in the shorter stroke reduced them to nearly the same proportion. Thus far the experiments given only serve to prove that, practically, a considerably better result has been obtained by a steam vessel built on the wave principle, than by a competitor built under conditions that are perfectly identical, in so far as the public and the owners are concerned. But as regards the purely scientific question, I shall add two other experiments with the wave vessel, which furnish data of a more permanent and precise nature—one at a higher, the other at a lower velocity:—

Experiments on the Wave Vessel.

I.	Velocity of vessel,	15·14	miles an hour.
	" of wheel,	18·17	"
	Slip,	3·03	"
II.	Velocity of vessel,	16·50	"
	" of wheel,	21·20	"
	Slip,	4·70	"

The area of midship section immersed was 89·4 feet.
The surface of vessel immersed was 3080·0 feet.
The area of paddle-floats was 26·8 feet.

The conclusion which I deduce from these last experiments is this, that by means of the wave form one may obtain a form of which the resistance shall be represented by $R = \frac{1}{20}$ A.H.S., instead of $R = \frac{1}{6}$ A.H.S., which is the lowest number given in any previous system of construction;—A being the area of midship section, H the height due to the velocity of the vessel, and S the weight of a cubic foot of water.

"On a Mode of Measuring and Correcting the Astigmatism of a Defective Eye," by Mr. G. G. Stokes.—Besides the common defects of long sight and short sight, there exists a defect, not very uncommon, which consists in the eyes refracting the rays of light with different power in different planes, so that the eye, regarded as an optical instrument, is not symmetrical about its axis. This defect was first noticed by the present Astronomer Royal, in a paper published about twenty years ago, in the *Transactions* of the Cambridge Philosophical Society. It may be detected by making a small pin-hole in a card, which is to be moved from close to the eye to arm's length, the eye meanwhile being directed to the sky, or any bright object of sufficient size. With ordinary eyes, the indistinct image of the hole remains circular at all distances; but to an eye having this peculiar defect, it becomes elongated, and when the card is at a certain distance, passes into a straight line. On further examining the card, the image becomes elongated in a perpendicular direction; and, finally, if the eye be not too long-sighted, passes into a straight line, perpendicular to the former. Mr. Airy has corrected the defect in his own case by means of a spherico-cylindrical lens, in which the required curvature of the cylindrical surface was calculated by means of the distances of the card from the eye when the two focal lines were formed. Others, however, have found a difficulty in preventing the eye from altering its state of adaptation during the measurement of the distances. The author has constructed an instrument for determining the nature of the required lens, which he described.

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* It is found to answer admirably for the revolving brooms in Mr. Whitworth's Sweeping Machine.—Ed. P. M. J.

"On the Friction of Water," by R. Rawson, Esq.—The object of this paper is to ascertain the friction of water on a vessel or other floating bodies rolling in water. For this purpose, experiments have been made upon a cylindrical model—whose length is 30 inches, diameter 26 inches, and weight 255·43 lb. avoirdupois—in the following manner:—The cylinder was placed in a cistern, in the first place, without water, and made to vibrate on knife-edges passing through the axis of the cylinder. A pencil projecting from the model in the direction of the axis of the cylinder on the surface of another moveable cylinder marked out upon paper placed upon this last cylinder the amplitude of each oscillation. The cylinder was deflected over to various angles by means of a weight attached by a string to the arm of a lever fixed to the cylindrical model—

Angle of Deflexion.	Angle to which the Model vibrated.
22° 30′	22° 24′
22 10	22 6
21 54	21 48
21 36	21 30
&c.	&c.

When the cylinder oscillated, in all circumstances the same as above, except being surrounded by salt water, the amplitude of oscillations was as follows—

Angle of Deflexion.	Angle to which the Model vibrated.
22° 30′	22° 0′
21 36	21 3
20 48	20 16
&c.	&c.

Clearly showing that the amplitude of vibration when oscillating in water is considerably less than when oscillating without water. In the above instance there is a falling off in the angle of amplitude of 24′, or nearly half of a degree. This amount has been confirmed by several experiments made with great care; and it appears only fair to attribute this decrease in the amplitude of oscillation to the circumstance of the friction of the water on the surface of the cylinder. The amount of force acting on the surface of the cylinder necessary to cause the decrease in the amplitude of oscillation shown by the experiment was calculated; and the author thinks that this amount of force is not equally distributed on the surface of the cylinder. In consequence of this, he thought the amount on any particular part might vary as the depth. On this supposition, a constant pressure at a unit of depth is assumed. This, multiplied by the depth of any other point of the cylinder immersed in the water, will give the pressure at that point. These forces or moments being summed by integration, and equated with the sum of the moments given by the experiments, we have the following value of the constant pressure at a unit of depth: ·0000469. This constant in another experiment, the weight of the model being 197 lb. avoirdupois, and consequently the part immersed in the water was very different from the other experiment, was ·0000452, which differs very little from the former,—showing that the hypothesis assumed in the computation is not far from the truth.

"On the Oscillations of Floating Bodies," by R. Rawson, Esq.—This paper had for its object the description of a course of experiments made at Portsmouth Dockyard by Mr. John Fincham, the master shipwright, and the author, with a view to confirm several important formulæ discovered by Professor Moseley relative to the rolling and pitching motion of vessels. All the experiments which were made by Admiralty order, confirm the formulæ for determining the amount of force or work done to deflect a floating body in a state of equilibrium through a given angle, and also another formula which determines whether the vessel thus deflected will move slowly or otherwise. The importance of these questions to naval architecture is obvious; and all the experiments we have made show what we believe to be an important practical fact,—viz. that when a sudden gust of wind is applied to the sails of a vessel, or any cause which acts constantly during one oscillation, the ultimate amplitude of deflexion will be double the amplitude which the gust of wind will permanently deflect the vessel. In the next part, several experiments were made on models of vessels, some of which have been built with a view to ascertain the best form of midship section which will give the easiest rolling motion.

"On the Heat of the Vaporization of Water," by J. P. Joule.—The object was to point out the complex nature of the heat hitherto taken for the latent heat of steam. In the exact experiments of Regnault, 965° was found to be the quantity of heat evolved in the condensation of steam saturated at 212°; of this quantity 75° is the heat due to the *vis viva* communicated by the pressure of the steam, leaving 890° as the true heat of vaporization of water. In a perfect steam-engine supplied with water at 212°, and worked at atmospheric pressure without expansion, 965° will be the heat communicated from the fire to the boiler, 75° will be the heat utilized by conversion into force, and the remainder 890° will be the heat given out in the condenser.

"On the Manufacture of the Finer Irons and Steel, as applied to Gun-barrels, Swords, and Railway Axles," by W. Greener.—The first innovation on the old principle of manufacturing gun-barrels entirely from old horse-nail stubs, was due to the late Mr. Adams of Wednesbury, who brought out what is termed Damascus iron, which is constructed of alternate layers of steel and iron fagoted, drawn down into rods, then tortuously twisted, and when welded into barrels forms the Damascus barrel. The success of this experiment, both in point of beauty and strength, was so great as to be under-estimated at 50 per cent. as compared with the strength of stub twist iron. The next experiment was to blend more intimately than the above, steel with the horse-nail stubs in the proportion of one to two of the latter. The paper described the mode of this; and then went on to narrate that the next and most important improvement in metals was the manufacture of gun-barrels from scrap steel entirely, and for this purpose old coach-wheels were generally in request: by clipping these into pieces, perfectly cleansing them, and welding in an air-furnace, a metal is produced which surpasses in tenacity, tenuity, and density, any fibrous metal ever before produced. The tenacity of it, when subjected to torsion in a chain-testing machine, is as 8 to 2½ over that of the old stub twist mixture. The perfect safety of barrels produced from it is astonishing; no gunpowder yet tried has power to burst them when properly manufactured. These experiments had induced others on a more extensive scale; to effect this, ingots of cast-steel were taken from the mill made to No. 3 in the scale of carbonization. These, after rolling into flat bars, were clipped into small pieces, immediately mixed and welded as before in the air-furnace, drawn down into rolls, and re-faggoted; these were subsequently drawn down, and were then ready for being made into gun-barrels, either with or without spirally twisting them; to form Damascene barrels from this was perfectly safe—this was ascertained by experiments. It was discovered that the density and tenacity of the metal was sufficiently great to effectually resist the enormous force of this great cast of gunpowder.—The manufacture of swords was another article to which this improvement applied. All the investigations of the writer had tended to satisfy him that the Arabs thus produced their finely-tempered Damascus swords; namely, using two steels of different carbonization—mixing them in the most intimate manner, and twisting them many fantastic ways, but observing method in that fancy; and it was a fact, that no European sword has ever yet been produced equal to the Damascus. The government inspector of small arms was of opinion that the swords made in Birmingham were not fit to be used in the army. The writer's investigations had satisfied him, that tempering by crystallizing the steel—that is to say, tempering in the ordinary way —was far from the wisest. The Damascus blade, in its fibrous state or hammer-hardened, is more difficult to break by 100 per cent. than the best English-made blade. This had been tried; but temper it in the same way, and it showed no greater tenacity than our own; the Damascene figure was destroyed by the carbon becoming equally diffused; nor would acid develop it—it was entirely gone. From these and other facts the conclusion might be drawn, that swords constructed of dissimilar steels—tempered by condensation of its fibres—either by repeated rollings, hammering, or many other processes, which our perfect machinery gave us the facility to do—are the best. Therefore, in time, we might hope to see every soldier of the empire armed with a weapon as good, if not so costly, as the highly-prized Damascene.

"On correct Sizing of Toothed Wheels and Pinions," by Mr. Roberts.—Although much has been written on this subject, and on the best form of teeth, there is still much difference of opinion on both points; which difference is not confined to individuals, as it embraces the members of the trade or profession to which they belong. For instance, engineers, millwrights, and machinists in general, adopt the plan of extending the teeth of the pinion and wheel to the same distance beyond the pitch-line. A majority of them are agreed as to the best form of teeth—namely, the cycloid for wheels to work in straight racks, and the epicycloid for wheels to work in other wheels, or in pinions. But they are not so well agreed respecting the length of the teeth; as the makers of watches, clocks, and chronometers do not extend the teeth of the pinion beyond the pitch-line more than one-half as far as they do the teeth of the wheel; hence the preference given by those trades to the "bay-leaf" form for the teeth of the pinion, as no other form would pitch, with their sizing.

Mr. Roberts observes, that various rules are given in works on horology for sizing wheels and pinions, but he believes "movement makers," generally, English and foreign, use an instrument called a "sector" (resembling a "two-feet rule"), which is divided into equal parts throughout its length, commencing about half a division from the centre of the joint. The numbers up to 10 or 12 on the sector are usually subdivided, for the use of artists who may prefer pinions a little larger than the corresponding number on the sector would give.

Knowing it to be essential to the correct performance of any machine where wheels and pinions are employed, that they should be properly sized, Mr. Roberts thought it might be useful to parties whose experience on the subject has been more limited than his own, of whom there might possibly be some present, to be informed respecting the plan which he has adopted for more than thirty years for sizing toothed wheels. With this object in view, he has constructed an instrument which represents, on a large scale, the sector used by clock and watch-makers; excepting that in their sector the divisions are marked on the inner side of the limbs, whilst in his sector the divisions commence at the centre of the joint, and are continued in a straight line to within about ¾ inch of the outer side of the limbs at the other extremity.

It has long been the practice in Manchester to make those wheels which come under the denomination of "clock-work" with some definite number of teeth to the inch diameter, taken at the pitch-line, and to distinguish the pitch accordingly. Mr. Roberts has done this, and has adopted the same plan in respect to mill-gear; substituting the foot for the inch in designating the pitch, instead of naming it by the distance from the centre of one tooth to the centre of the next, which is, he believes, the universal practice.

Before explaining the way in which his instrument is used, he mentioned that in the year 1816 he had a set of change-wheels made by a "factory clockmaker," which wheels were so much out of pitch as to direct his attention to the cause of the defect; and having found that the error had arisen from the defective principle of the sector, he immediately contrived his sector, which differs from the clockmaker's sector principally in the joint being adjustable like that of the proportionable compasses. The use of this kind of joint was to enable parties to pitch wheels correctly, and to suit themselves as to the depth of the teeth.

After he had sold a number of sectors of this kind, he found that, for all ordinary purposes, a fixed joint would answer equally well, provided the centre of the joint was equal to two of the divisions of the sector below zero. This circumstance led him to make sectors (bars of brass serrated on the edge) which are cheaper, whilst they are better suited for the workshop.

This kind of sector, which, he believes, is made by his firm only, has the tenth number at the twelfth division from the starting point; the two divisions being added for the depth of tooth beyond the pitch-line. There are two scales on each of these sectors, one on each edge; which scales are marked according to the number of teeth to the inch diameter (pitch-line) they are adapted for. They are made in sets ranging from 3 to 30 in the inch. One set of these sectors is used for sizing working-wheels, and another set for sizing pattern-wheels; the latter is one per cent. coarser than the former, to compensate for contraction of the metal in cooling.

SECTION B.—CHEMISTRY, INCLUDING ITS APPLICATIONS TO AGRICULTURE AND THE ARTS.

"Report on the Oxidation of Rails in and out of use, determining the Loss by Abrasion," by Mr. R. Mallet.—Mr. Mallet has paid much attention to this subject, and he has concluded that the top surface of a railway bar in use is constantly preserved in a state of perfect cleanliness, freedom from oxidation and polish; while the remainder of the bar is rough-coated originally with black oxide, and soon after with red rust (peroxide and basic salts). Not only is every metal electro-positive to its own oxides, but, as established in the second Report on the action of air and water on iron, the polished portion of a mass of metal partially polished and partially rough, is primarily corroded on the rough portion. Hence a railway bar while in use is constantly preserved from rusting by the presence of its polished top surface. Such polished surface has no existence on the rail out of use. The upper surface of the rail in use is rapidly condensed and hardened by the rolling of the traffic over it; and it is also shown in the above Report, that, all other circumstances being the same, the rate of corrosion of any iron depends upon its density, and is less in proportion as this is rendered greater by mechanical means. As every metal is positive to its own oxides, the adherent coat of rust upon iron, while it remains, powerfully promotes the corrosion of the metal beneath, and this in a greater degree in proportion as the rust adherent is of greater antiquity. It has been shown that the rust produced by air and water, which at first contains but little peroxide, continues to change slowly, and becoming more and more peroxidized, becomes more and more electro-negative to its own base. Now, the rust upon a railway bar out of use continues always to adhere to it, and thus to promote and accelerate its corrosion; while the rust formed upon a railway bar in use is perpetually shaken off by vibration, and thus this source of increased chemical action removed. To recapitulate, railway bars forming part of a long line, whether in or out of use, corrode less for equal surfaces than a short piece of the same iron similarly exposed. Rails in use do corrode less than those out of use. This difference is constantly decreasing with the lapse of time. The absolute amount of corrosion is a source of destruction of the rail greatly inferior to that due to traffic. It is highly probable that the electrical and magnetic forces developed in the rails by terrestrial magnetism, and by rolling traffic, react in some way upon the chemical forces concerned in their corrosion; and that, therefore, the direction of lines of railway in azimuth is not wholly indifferent as respects the question of the durability of rails. The author concludes with two practical suggestions, deducible from the information obtained:—1st, Of whatever quality iron rails are rolled, that they should be subjected prior to use to an uniform course of hammer-hardening all over the top surface and sides of the rails; and, 2dly, that all railway bars, before being laid down, should, after having been guaged and straightened, be heated to about 400° Fahrenheit, and then coated with boiled coal tar. This has been proved to last more than four years, as a coating perfectly imprevious to corrosive action, while constantly exposed to traffic.

"On a continued Spontaneous Evolution of Gas, at the village of Charlemont, Staffordshire," by Mr. S. S. Howard.—In a field by the side of a lane near the village of Charlemont, in Staffordshire, certain patches of ground had been noticed which, without any apparent cause, were destitute of vegetation. They excited little attention, as they were supposed to be what are commonly called fairy rings; and it was not till the summer of 1846 that their true character was discovered. The person who first paid particular attention to the cause of these barren spots, was the tenant of a neighbouring cottage (at which there is a cold bath noted in the vicinity for its sanative properties). From certain circumstances he was led to believe that something permeated the earth in those spots; and having dug a hole, he inserted a gas-pipe, and on applying a light to the mouth of the pipe, he found to his great surprise that a large flame issued from it. It was not long before he conceived the idea of applying it to domestic purposes, and in pursuing his experiments he found that it was not necessary to convey it from the place where it was first discovered, at a distance of about 150 yards from his house, as on driving a pipe some inches into the ground under the floor of the cottage, he produced a continuous flow of gas. There are, at the present time, seven burners in the cottage, which enable the owners to dispense with fire and candles. The next cottage is also supplied with two. It appears to make no difference to the supply of gas if allowed to burn for weeks together, and the flame is always of the same colour. In windy weather the flame is generally unsteady; when there is a blast of wind outside, the flames of gas rise several inches, but as each blast dies away they return to their original size. The escape of gas is larger in wet weather than in dry; but whether the gas is produced near the surface or otherwise, has not yet been satisfactorily ascertained. The place where it issues from the earth is quite a mile from any coal-pit, and is outside the eastern edge of the Staffordshire coal-basin. The gas, as analyzed by myself, (from a portion of it procured for me by Mr. S. Lloyd, jun., of Wednesbury, about three miles from the place,) was composed principally of light carburetted hydrogen. In 1000 volumes of the gas as it rises, I procured 996 volumes of light carburetted hydrogen, 3 of carbonic acid, and 1 of aqueous vapour and nitrogen. Its specific gravity is ·56126. Its composition is somewhat different from the gas known as marsh gas, and from that which collects in the old workings of mines, as it contains less carbonic acid and less nitrogen. The proportions in marsh gas of the former being $\frac{1}{20}$, and of the latter $\frac{1}{15}$ to $\frac{1}{20}$, whereas in this gas the proportions are only $\frac{3}{1000}$ and $\frac{1}{1000}$. It burns with a pale blueish-white flame, emitting considerable light and heat. Mixed with atmospheric air or oxygen, it explodes with considerable violence on contact with flame or the electric spark. As it issues from the pipe it has a moist or slightly musty smell, as of sticks partially decomposed; but after keeping for some time in stopped glass jars, this is lost, and it becomes perfectly inodorous. When inhaled in large quantities it produces the same effects as hydrogen gas, but it does not appear to exert any evil influence on the health of the inhabitants of the cottage when diluted with a large portion of atmospheric air.

Mr. Blackwell, of Dudley, showed that a series of faults converged to the area of this singular evolution of gas, and suggested that probably it was through these that this carburetted hydrogen was discharged from the extensive carboniferous deposits of the neighbourhood.

"Analytical Investigations of Cast-Iron," by Mr. F. C. Wrightson.—This series of analyses showed the influence of the hot-blast in producing the so-called "cold short iron," by occasioning an increased reduction of phosphoric acid, and the consequent increase of phosphorus in the "hot-blast" iron. The respective per centages were—

	1	2	3	4	5	6	7
Cold blast,	0·47	0·41	0·31	0·20	0·21	0·03	0·36
Hot blast,	0·51	0·55	0·50	0·71	0·54	0·07	0·40

The irons differed also considerably as to the state in which the carbon was contained in the hard white iron, resembling impure steel, containing nearly all its carbon in a state of chemical combination, whilst the carbon contained in the grey and mottled varieties of iron was principally contained only as a mechanical mixture. The presence of sodium and potassium in all the specimens examined was also noticed for the first time, and it was thought probable that these might materially affect the qualities of the metal.

"On Copper containing Phosphorus, with details of Experiments on the Corrosive action of Sea-Water on some varieties of Copper." By Dr. Percy.—Upon analysing a specimen of copper, to which, when in a state of fusion, some phosphorus had been added, it was found that it contained a considerable quantity of phosphorus, and also a large portion of iron derived from an iron-rod employed in stirring the mixture at each addition of the phosphorus. The copper employed was of the "best selected,"—it appeared to be harder than copper treated with arsenic. The details of the analysis of 116·76 grains were given, the result of which was—

Phosphorus,	0·93
Iron,	1·99

A second analysis gave—

Copper, ...	95·72
Iron,	2·41
Phosphorus,	2·41
	100·54

It has long been stated that a very small quantity of phosphorus renders copper extremely hard, and adapts it for cutting instruments; but such an alloy as that formed by Dr. Percy has not previously been formed. It is a remarkable fact, that the presence of so large a quantity of phosphorus and iron should so little affect the tenacity and malleability of the copper. The effect, also, of phosphorus in causing soundness in the casting of copper is interesting, and may be of practical importance. Some experiments were next described, made by Captain James of Portsmouth, bearing on the economic value of the alloy of phosphorus and copper. By the experiments made by Captain James on the corrosive action of sea-water, it would appear that this compound was much less affected than most other specimens of copper tried. The results derived from exposing measured pieces of copper to the action of sea-water for nine months were as follow:—

	Grains.
Electrotype copper, loss per square inch,	1·4
Selected copper,	1·1
Copper containing phosphorus,	·0
Copper from the "Frolic,"	1·12

		Grains.
Dockyard Copper,	No. 1,	1·66
Do.	No. 2,	3·
Do.	No. 3,	2·48
Do.	No. 4,	2·33
Muntz's Metal,		·95

The results appear to be of sufficient importance to excite attention to the fact, and to elicit further inquiry, especially when it is remembered how important and economic a desideratum it is to the Admiralty, to diminish or prevent the corrosive effect of sea-water upon copper.

"On an Improvement in the preparation of Photographic Paper, for the purpose of Automatic Registration, in which a long-continued action is necessary," by C. Brooke.—The preparation of the paper described may be thus briefly stated:—The paper is washed over by a brush with a solution of 12 grains of bromide of potassium, 8 grains of iodide of potassium, and 4 grains of isinglass, in one fluid ounce of distilled water, and dried quickly. When about to be used it is washed over by a brush with a solution of 50 grains of nitrate of silver to one fluid ounce of water, and placed on the cylinder of the registering apparatus, on which it remains in action for 24 hours. When removed, the impression is developed by brushing over a warm solution of gallic acid, containing twenty grains in the fluid ounce, to which a little strong acetic acid is added, and is then fixed with a solution of hyposulphite of soda in the usual manner. The present improvement consists in rinsing the paper in water after the application of the solution of nitrate of silver, pressing out the superfluous moisture in folds of blotting paper, and then adding a little more of the solution of nitrate of silver to the surface of the paper. This is most conveniently effected by pouring a small quantity on the paper, and then pressing a glass rod or tube lightly over the paper, by which the solution is evenly distributed over the surface, and the contact of organic matter avoided. The increased sensibility and improved cleanliness of the paper, consequent on this addition to the process, are presumed to depend on the removal, by washing, of the nitrate of potash formed by the mutual decomposition of the salts on the surface of the paper.

A new form of Galvanic Battery was exhibited to the Section by Mr. W. H. Walemi, in which two plates of cast-iron were placed as near as possible, without being in contact with, a plate of zinc, stated to be prepared by precipitating lead from a solution of the acetate upon it, and then amalgamating it. Its merits were said to consist in its constancy of action.

MONTHLY NOTES.

The Screw Propeller *versus* Paddle Wheel.—The question of the relative merits of the side wheel and screw propeller, as methods of applying steam power to the purposes of navigation, is one which has of late years engrossed much attention from engineers, and seems still to be undecided; for the repeated failures which have hitherto induced so great a want of confidence in the latter form of wheel, may, we think, be attributable, not to the falsity of the principle involved, but to its injudicious application. So far as theory is concerned, the screw propeller presents many and great advantages over the old plan, and as the results of practice do not appear to correspond to the hopes of improvement held out, we think that an inquiry into the reasons of such a discrepancy may not be amiss. The advantages which should result from the use of the propeller are briefly these: a decreased cost and increased stowage for freight, and a more economical and equable result from the engine; both of which will, we believe, appear reasonable from the following considerations:—First, to develop an equal amount of power, propeller engines may be made much smaller than those for side wheels; for, by "equal power," is to be understood an equal amount of water converted into steam, and used (at the same point of expansion) in a given time, or, as implying the same thing, an equal amount of boiler surface. Now, as propellers may be worked at a much higher number of revolutions than side wheels, it follows that a proportionably smaller cylinder may be used, in order to develop the same power. The engines, therefore, being smaller, will of course be less expensive, (making the whole cost less,) and will require less room in the vessel, thereby leaving more room for stowage. That this latter is not a trivial consideration, will appear from the fact that a pair of ordinary side lever engines, (which are generally used in this country,) attached to side wheels, require more than twice the space demanded by engines of the same capacity placed transversely in the vessel for attachment to the propeller shaft, not to mention an equal disparity in the *weight* of the machinery, whose diminution permits a decreased draft of water, and thereby lessens the resistance, or increases the speed of the vessel with the same consumption of fuel. As an example of this position, two side lever engines for a steamer of 900 tons require a space of 7500 cubic feet, and will weigh, including wheels, shafts, &c., 130 tons; while a pair of propeller engines for the same vessel, to give the same power, require 3500 cubic feet, and will weigh but 70 tons, including the propeller and shaft; thus effecting a saving of 60 tons and 4000 feet of space, which is equivalent to a stowage of 110 tons. So that nearly one-seventh more *weight* may be transported at the same expense, or, if the cargo is of a bulky nature, *one-fourth* more freight may be carried without increasing the resistance. But, secondly, we argue that the use of propellers admits of a more economical and equable action in the engines. For a screw propeller, *properly constructed*, always acts upon the water through every point of its surface with precisely the same pressure, because, in such a wheel, every point will advance through equal distances in the same time, thus making available every inch of the blades as propelling surface; while, in side wheels, however large they may be, there is always a considerable difference in the velocities of the outer and inner points of the bucket, so that a portion of the bucket is *dragged* by the vessel, or is at least comparatively useless, while another portion moves at a velocity far exceeding it, and a part of the propelling power of the wheel is expended without an adequate result. Besides which, the side wheel acts upon the water, not in a direction opposite to the motion of the vessel, but enters and departs from it at an angle which increases with a diminution of the diameter; while, in the screw, the pressure against the water is uniform in amount, and constantly in a direction parallel to the vessel's motion. A practical proof of the value of such advantages is found in the fact, that the "slip" in the side wheel varies from 25 to 30 per cent., and in the propeller, when of proper form, only 15 to 18 per cent. In heavy weather at sea, this disparity becomes still more strongly marked, for here the motion of the vessel, and of the sea, causes the paddle wheels to be alternately immersed to a great depth, and entirely raised out of the water, thereby producing two evil effects: 1st, to yaw the vessel from side to side, and of course increase her resistance, it being evident that the continued immersion of one wheel only would cause the vessel to turn round; and, 2d, to produce an irregular and very trying strain on all parts of the engine, but especially on the shafts. If, then, these are some of the advantages which ought to result from the use of the screw propeller, the question naturally presents itself—Why has not experience verified so plausible a theory? What have been the causes of so many failures? We need only point to the numerous small propeller craft which ply along our coast, to prove that at least one branch of our trade has received a valuable auxiliary in the screw; and we think that the reasons why it has not been equally successful in marine navigation on a larger scale, and involving a higher speed, are principally to be found in a want of knowledge and calculation of the relations which should exist between the means and the end. It must be remembered that, while the talents and experience of the last forty years have been expended, both in England, France, and America, in perfecting the side wheel and its applications, only ten years have elapsed since the screw propeller was introduced to the American public, of which five only have gone by since the first successful application of the principle to a large sea steamer; that while the examples of the first-named plan are numberless, both in the old world and the new, those of the last are but few in number, and generally made under discouraging auspices; that while the former has received the sanction of continued and successful use, the latter has to contend with that prejudice which always exists against new inventions; and, with these things in view, can it be a matter of surprise that there should be repeated, and, in some cases, disastrous failures? We have yet to learn from that expensive teacher, Experience, the best form to be given to the propeller, a point which has never been so decided as to leave no room for discussion. We have to learn the best shape for the vessel; for why, if side-wheel steamers require a different form from sailing vessels, should it be unreasonable to suppose that the two kinds of steamers require different proportions? And, more than all, we must trust less to guess-work, and use more calculation, both in proportioning the engines and propellers to each other, and to the work they have to do, and in disposing the machinery in the hull with a view to the speed and sea qualities of the steamer. This is, we are aware, a simple thing, and one easily arrived at; yet three-fourths of the failures which have disgraced the cause of propellers have been due, in great part, to an utter want of the necessary calculations. And, despite the triumphant attitude of the advocate of side wheels, when pointing to the long list of sea steamers upon that plan, now built or in process of construction, we venture to predict the time, not far distant, when the experience of our commercial marine shall vindicate the just claims of the screw propeller, and entitle it to a higher degree of consideration than the much-vaunted side wheel itself.—Helix.

Now for the opposition side:—

> "An ounce of fact is worth a pound of fiction."

In perusing the article on screw propellers in the last number of the Journal, by "Helix," I gather the following points, as being what he wishes to be understood as advocating:—1st, That propellers, running, as they do, at a higher velocity, admit of the use of smaller engines, thereby causing a saving of space and weight, as well as being cheaper in first cost. 2d, That the slip of the propeller is but 15 to 18 per cent. 3d, That the machinery of propellers, being of less weight and bulk, will allow of a less draft of water, and thereby materially reduce the resistance and increase the speed of the vessel. 4th, In heavy weather, at sea, the advantages of the propeller over the side wheel are very marked; for, while the former is working with uniform power, the latter are being alternately immersed to a great depth, and entirely raised out of water, causing the vessel to *yaw* from side to side, &c. 5th, The propeller, as now used, is not *properly constructed*. The numerous failures that have taken place are caused by a want of knowledge and calculation of the relations which should exist between the means and the end. After reading the above, one may well inquire by what right a Cunard steamer crosses the ocean in ten days? or further, why, with a west wind all the way, she arrives at all, instead of a day or two behind time, when she ought to be at sea, *yawing* about, with one wheel in the water and the other *out?* And what is still more presumptuous on their part, the slip of their wheels is but 15 to 20 per cent. Now, if we only consider that a portion of the wheel, according to "Helix," is being *dragged* through the water, and the *balance* operating at an angle, and not in a direction opposite to the motion of the vessel, I think we may well say that *that small portion* of the wheel that does the work is entitled to great credit for the exceeding regularity of its performance; and if that portion that *drags* should be cut off, what might not be expected even from side wheels? In making a comparison between the engines of propellers and side-wheel steamers, "Helix" very modestly takes direct-action engines for the former, and gives side-lever engines to side wheels, although he very well knows (if an engineer) that direct-action engines are in common use for side wheels in England, and that, in the very case he has stated, a vessel of 900 tons may have oscillating engines in the space he has given to those for the propeller. I do not claim, however, that proper engines for side wheels can be put in the same space that some form of engines for propellers may be made to occupy, but the difference in space is very far from being what "Helix" would make it appear; and when the following points are considered, all of which *I am prepared to establish* by testimony that will not be questioned even by "Helix," I think that the friends of side wheels may venture to breathe more freely, at least, until they are again demolished, or until the appearance of a screw propeller *properly constructed*. 1st, That the models of vessels with the screw are, of *necessity*, cut away at the stern, and that this reduction of displacement is from 5 to 10 per cent. of the capacity of the vessel, and that the loss of stowage from this necessary evil is greater than the difference of size and weight between the engines of the different vessels. 2d, That the loss of steam by the use of small engines running at high velocities, as recommended by "Helix," is *double* what it will be in a paddle-wheel steamer of the same size. 3d, That propellers do not admit of a lighter draft of water than side-wheel steamers, it being a well-established fact, that even moderate success with them is connected with more than the ordinary draft for vessels of the same class using side wheels. 4th, That in no case has the screw any advantage over the side wheel as a means of propelling; that with the wind abaft, abeam, or ahead, the side wheel is the best; and that its advantages are most fully seen with the wind ahead, that being the point where all *theoretical* screw men claim the advantage; and in proof of this I adduce, 5th, That the slip of all sea propellers in this country, in heavy weather, with wind ahead, is from 50 to 60 per cent., as shown by their authentic log-books. That the "Princeton" will fall off but 4 revolutions of her engine (from 32 to 28) with the wind ahead, while her speed will be reduced from 8 to 4 miles per hour; while the "Mississippi," under similar circumstances, will fall off from 14 down to 7 revolutions; and that while in the "Princeton" they will be using all the steam they can make, in the "Mississippi" they can run with the fire of two boilers banked up. 6th, That what is true about the "Princeton" is also true of the "Legare," "Massachusetts," and all sea propellers where authentic logs are kept. 7th, That the wear and tear of engines for propellers, from their high velocity, far exceeds that for side wheels, being a liberal per centage on treble the difference of cost. 8th, That the side-wheel steamers running from New York to Savannah average their trips in less time than the propellers from this port to Charleston, although the difference in distance is 8 to 10 hours in our favour. 9th, That the paddle wheel of to-day is the same as used by Fulton in 1807, and that while, by its aid, we can with certainty cross the Atlantic, and with a regularity and speed that almost surpasses belief, the best efforts of all the *genius* and *talent* of the various advocates for propellers, in this country and in Europe, has not produced a sea steamer of *speed*. No one is more willing than myself to admit that, for some particular services, propellers may and will be used to advantage; but for packets, steamers to Europe, or sea steamers to any port where speed is an object, and there is any opposition, side wheels will be preferred, defective as they are stated to be. "Helix" *must go to sea;* he must try a passage on both kinds of vessels, in heavy weather if possible, and I think he will agree with me, that the extremity of a sea vessel is not the place for the propelling power.—*Franklin Jour.*

Rye's Power-Loom Taking-Up Roller.—Mr. Rye, of the Lower Moor Iron Works, in Manchester, has registered an ingenious species of taking-up roller, intended as a substitute for the usual emery or glass-coated roller. It is of iron, lacquered to keep off the attacks of rust, and chased right and left from the centre, being afterwards fluted across the chasing—that is, in a direction parallel with the axis. This surface is stated to have a tendency to keep the cloth wider than the ordinary roller, and it answers for stronger cloth. We observe that the old system of flat temples is being rapidly superseded by the rotatory one, to which the powerfully adhesive property of india-rubber has been ingeniously adopted as a holding surface.

Cocoa-Nut Fibre as an Article of Manufacture.—Among the inventions and adaptations of late years, that of the use of cocoa-nut fibre, in textile and other manufactures, has sprung up to a very considerable extent. We have seen excellent matting, rugs, and mattresses, made of this material, as well as all kinds of cordage; and lastly, brushes. One of its uses, worthy of the farmer's consideration, is as a netting for sheep-folds, taking the place of the cumbrous and expensive hurdles. The stiff fibres answer for the manufacture of brushes of all kinds, as they give a clean, sharp action.

Ridgway's Sanatory Pottery Water-Closet. — Mr. Ridgway, the eminent manufacturer of fictile ware, has lately produced a domestic convenience of some importance in connection with the now wide-spreading sanatory movement. As shown in the design before us, it is extremely neat, and in its arrangement it is equally well suited for the cottage as the palace. Compared with wood, the newly-applied pottery will be found to possess many and eminent advantages in cleanliness, cheapness, and elegance.

The Cottager's Stove.—This name has been given by the inventor, John Grant, Esq. of London, to an ingenious contrivance, intended as a warming and cooking stove, suitable for introduction to the humblest dwellings in point of economy and simplicity. It consists of a rectangular chamber, 24 inches long, by 14 inches wide, and the same depth, mounted on four legs, to stand 22 inches high. The fire is contained in a small receptacle, arranged on the common fire-pot principle; or, to explain it clearer, it is somewhat like a crucible with bottom fire-bars. A flue passing from the top of the fire-holder, runs across the top of the chamber to the chimney, and from this, as well as from the direct radiation of the fire-holder, the heat for the main chamber is derived. The fire-holder has both a top and side door, and ash slide, and a second and larger side door gives admission for the articles to be cooked to the interior of the chamber. Mr. Grant has carried out the plan on an extensive scale at his own residence in Hyde Park Street, where the success of the design has been placed beyond a doubt by a three years' actual use. It requires no fixing, has no impracticable flues, and where it is applied, the evil of smoke disappears. It is recommended most strongly by the Metropolitan Association for Improving the Dwellings of the Industrious Classes, which society derives all the benefit arising from the sale of the registration labels. To Mr. Grant all praise is due for his disinterested exertions in placing so useful a piece of domestic furniture within the reach of all who can afford 40s. for their heating apparatus.

Battersby and Telford's Self-Revolving Sheave.—The title "self-revolving" has been given by Messrs. Battersby, Telford, & Co., of the Waterloo Foundry, Liverpool, to a novelty in the way of sheaves for block-tackle. A set of five anti-friction pulleys are mounted on stud-shafts, carried in bearings in the arms of the sheave, their inner surfaces bearing against a dead centre, which carries the sheave. The centre is conical, in three steps or divisions, and the rounded peripheries of the circle of pulleys fit into a grove formed round the centre division. The apparent object is to carry out the anti-friction pulley system proposed by Coles and others, so as to diminish the friction and wear upon the bearings; but it is not very easy to see how it is "self-revolving."

What Sea-Water contains.—Three French philosophers, M.M. Malaguti, Durocher, and Sarzeaud, have lately been prying into the secrets of the ocean—"calling spirits from the vasty deep." They are stated to have detected the presence—although they have not been fortunate enough to meet with much of the substance—of silver, copper, and lead. The water possessing these metallic accompaniments was picked up off the coast of St. Malo, some leagues out at sea. The same district also appears to grow its own silver, for in the ashes of the fucoidal plants was found 1-100,000th part of the precious metal, whilst the sea-water only gave 1-100th of that amount. The same explorers state that they have found silver in sea salt, in muriatic acid, and in common soda, as well as in the rock salt of Lorraine. We do not know whether any of the metals have yet been coined; but a judicious application of a strict course of homeopathy will doubtless render this an object of easy attainment. Dumas found fat in a bundle of hay—why may not our sea-bathers enrich themselves from their marine ablutions?

The Artisan's Home.—Although no advocates for that excessive spirit of joint-stockism which is but too frequently a concomitant of what the jargon of the day terms social progress—we can afford some sympathy for undertakings like this. The "artisan's home" is a large building, lately erected in Spitalfields by the Association for Improving the Dwellings of the Industrious Classes, as a place of residence for single men. Sufficient accommodation is provided for 234 men, upon the principle usually adopted in club-houses. Admission is obtainable by any respectable working man, on application to the superintendent, to whom he must pay 3s., as well as a small sum as a deposit, on account of the articles of crockery, &c., supplied to him. He is then a tenant for a week, and has a sleeping apartment of 8 feet by 4 feet 6 inches to himself, fitted up with the usual necessaries, with access to a large coffee-room on the ground-floor. All the arrangements appear to be of the most substantial and comfortable character; but there is a strong and a very natural feeling amongst the artisan classes against this club system. The plan may do very well for certain grades of single men, but the English workman has too much of the idea that his house is his castle, ever to permit it to be carried into very extensive practice. Anything, however, is better than the squalid dens which the Association purposes to root out; and if the present movement has any effect in this way, we need not say that it will be deserving of the deepest consideration.

Decoration for Interiors.—The Union Club-House of that seat of the aristocracy of manufactures—Manchester, has lately received some decorations which indicate a healthy state of feeling in that quarter. A series of panels from the cove to the surbase having pilasters, decorated between with arabesques, forms the groundwork of the decorator's plan; and, to give variety, medallions representing the hours, months, and zodiacal signs are introduced. The cove is filled with allegorical paintings, and the cornice is successfully relieved by arrangements of the poppy and convolvulus. In the dials of a clock and anemometer, an ingenious novelty has been introduced, by the adaptation of a group of lilies springing from a centre, the stamens being tipped with gold, as indices of the hours. The improvements have been carried out by Mr. Froggot of Manchester, the designs for the ornaments are by Mr. G. Jackson, and the allegorical paintings by Mr. Horner of London.

Literal Numeration. — Our old correspondent on the "decimal coinage" system, has forwarded us an extensive communication on "Literal Numeration," —representing numbers by letters. As his remarks extend beyond the limits of our available space, we shall let him introduce the subject in his own way, and then briefly state the peculiarity of his ingenious proposition.—"With the method of representing numbers by Roman capital letters, most persons are familiar; *or, at least, those are who read their Bible.* The chapters in the Bible are always numbered after that manner, as are generally the divisions of all books whatsoever. It is a truth, that there are very few books in the English language in which the Roman method of numeration is not more or less used. Considering this attentively, it will be evident that there must be a good reason for so universal a custom. That reason is found to be, the convenience arising from the use of two distinct systems of numeration; for no one can justly deny, that much confusion is thereby avoided, and many advantages gained. By numbering the principal divisions of a book with letters, and the minor with figures, the difference is very plainly marked, and reference to any place made easy without the necessity of writing aught but the two numbers. Thus, Gen. IV. 20, is understood by every one. So, in any other book divided into chapters and paragraphs, the capitals indicate the chapter, and the figures the paragraph. In poetry it is the same.

thus, Par. Lost, XII. 19, refers to the nineteenth line of the twelfth book of Paradise Lost; and in plays, the acts and scenes are denoted in like manner. In mathematical works, the books and propositions are in like manner distinguished; since by Euclid I. 47, the first book and forty-seventh proposition is signified. These examples show the utility of the plan; and a thinking mind will soon discover, that if only figures were used, then either must the different divisions be expressed, or confusion and indistinctness would be unavoidable. Seeing, then, that the use of Roman numerals is attended with so many advantages, it would not be well to disuse them; and it only remains to investigate their origin, in order to discover the principles of their formation, and also to ascertain whether a system of *letter numbers* can be devised, superior to the Roman in simplicity and brevity. As human knowledge is progressive and ever-increasing, it is evident that the sciences (however well understood now) were once unknown, and have, like every human being, passed through a state of infancy; and likewise, that there was a time when every invention was crude and imperfect, however perfect it may now appear; and that, like some mighty river, it has had its origin in a little bubbling spring. Every machine, however complicated, has existed in a very simple form, and very likely has its prototype among savage and less civilized nations. As there exist now nations that have no written language, so all those who possess one were once without the same. The alphabets of all nations have undoubtedly originated from very simple forms, and all letters, however different, can be traced to be combinations of straight lines, which, for convenience sake, have, in many instances, merged into curved, and combinations of straight and curved lines. Figures, or representations of numbers, can easily be traced to the same source; and it will strike every one that the simplest, and no doubt the primeval, mode of representing numbers, was by means of straight strokes, repeated till they equalled the intended number. This mode of scoring, as it is called, is still much used both by civilized and uncivilized nations. But it would soon be found that this method was too tedious and troublesome not to require amendment; and combinations of straight lines would be used for large numbers. This is the origin I assign both to the numerical characters, 1, 2, 3, 4, 5, 6, 7, 8, 9, and also to the Roman capitals, I, II, III, IV, V, VI, VII, VIII, IX, which respectively represent the same number. Both codes have originated from different combinations of straight strokes; which happening to be arranged by the Romans so as closely to resemble certain of their capital letters, they have chosen to use those letters; whereas, in the former case, the Arabians, having rounded the corners of their symbols, retained them distinct from their letters. It is not likely that the Romans chose those particular letters, representing the nine units, at random; because, if they had determined upon employing letters instead of symbols, it is reasonable to suppose that they would have followed the plan of the Greeks, and have taken the letters in their proper order, just as the Greeks chose ά, β΄, γ΄, δ΄, ε, ζ΄, ή, θ΄, ί, to represent those same numbers; and therefore it follows, that they adopted those particular letters from their close resemblance to the straight strokes that were first used to express numbers. The following figures will represent the original forms of the nine units: I, II, III, IV, V, VI, VII, VIII, IX, which were represented by the capitals, to avoid employing symbols expressly for numbers. The number *ten* was represented by X, because that letter resembles X, the symbol for *ten*, being two fives joined; so *five* was represented by two straight lines inclined and meeting diagonally, in preference to repeating five straight strokes. It will easily be perceived that these ten first numbers are produced by repetitions up to three, and then by combinations of the same straight stroke or line, and therefore that they all can be marked on any soft material by a single tool or "punch," that will make a straight mark, as every mechanic knows. Such was the origin of the Roman method of numeration, and the derivation of the first ten numbers. Their mode of representing larger numbers by using combinations of the fundamental numbers, and employing the initial capitals of the names of some to denote the same, is too generally known to require explanation. But however simple and convenient to a superficial observer the Roman method of numbering may seem, yet, upon a closer examination, it will be found redundant and inconvenient. By referring to the letters which represent the units, it will be seen that the straight stroke is repeated three times to form *three* (III.), *four* (IV.), *six* (VI.), and *nine* (IX.); four times for *seven* (VII.); and five times for *eight* (VIII.); while for *three*, three letters are required, and for *eight*, four. Compare these lengthy symbols with the common digits, and with the Greek units, and it is seen that in these two latter systems, *only one symbol* is used for each number. Now, as the unit characters are the touchstone of the excellence of any system, it follows, that as these in the Roman are unnecessarily long, so will the entire numeration be excessively cumbersome; because units enter into the composition of the bulk of numbers. All this might have been avoided, if the Romans had but used single letters for each unit. In their capital letters could have been found many composed entirely of straight strokes; and the fundamental straight lines could easily have been combined so as to resemble some of those same capitals. As with letters, so it is with numbers: although absolute sounds and numbers must ever remain unaltered, yet the character by which those sounds and numbers are represented may be varied infinitely; and it is quite immaterial what the forms of those particular characters are, so that their signification be agreed upon, and understood by all who use them. Knowing this, and having for my aim simplicity, brevity, and utility, I have ventured to submit to public approbation a new method of expressing numbers by Roman capital letters, which is called "Literal Numeration."—From this may be gathered the point of *Jacia's* scheme, namely, that a single letter may be conveniently used to represent each of the nine units, bearing in mind, that all the letters so employed are formed by a combination of straight strokes only. He gives a tabular statement, comparing the values of the *Roman* and *literal* methods of numeration, and in this he certainly exhibits a fair case on his side of the question. Like all sweeping novelties, however, the new plan has yet to be learned.

Cutting Ice by Steam.—In turning over every imaginable proposition for affording succour to the lost Arctic voyagers, the idea of employing the direct action of steam to cut through the ice has been tested at Woolwich Dockyard. Six blocks of ice, each $2\frac{1}{4}$ inches thick, by a yard square, were placed one upon another, so as to form a total thickness of about 14 inches, and upon these a jet of steam, at a pressure of 50 lbs., was directed from a flexible hose of $1\frac{1}{2}$ inch bore. The effect of this was to cut through the whole thickness in 55 seconds. The result is rather extraordinary; but what would be the power of even fifty steam-jets against the ice that is met with in the polar regions?

Death of Lieutenant Waghorn.—It is with much regret that we read of the death, at the age of 49, of this most enterprising man, whose eminent services in the improvement of the route to India, we have been but too slow to recognize. He had only just returned from Malta, where he had been endeavouring to recruit after his great exertions, which had caused a break-up of the system thus early brought to a fatal termination. Seeing that his life has paid the forfeit of his unwearied assiduity, it is to be hoped that the government pension, recently conferred upon him, will be continued to his widow.

ENGLISH PATENTS.

Sealed from 12*th December*, 1849, *to* 18*th January*, 1850.

Robert Harcourt, Birmingham, manufacturer,—"Certain improvements in knobs, handles, and fastenings for doors and drawers, and in fastenings to be used in fastening window-sashes, curtain and other rods, and for other like purposes."—December 15th.

James Oldknow, Lille, France, lace manufacturer,—"Improvements in the manufacture of lace and other fabrics."—15th.

Henry Roberts, Connaught-square, Hyde-park, gentleman,—"Improvements in the manufacture of bricks and tiles."—15th.

George Wythes, Reigate, Surrey, contractor,—"Improvements in apparatus for receiving and retaining the rails of railways."—15th.

Alfred Dalton, West Bromwich, Stafford, ironfounder,—"Improvements in reverberatory and other furnaces."—15th.

Charles Cowper, Southampton-buildings, Chancery-lane,—"Improvements in instruments for measuring, indicating, and regulating the pressure of air, steam, and other fluids, and in instruments for measuring, indicating, and regulating the temperature of the same, and in instruments for obtaining motive power from the same."—(Being a communication.)—15th.

Charles Lizars, Paris, engineer,—"Improvements in gas meters."—(Being a communication.)—15th.

Thomas Rock Shute, Watford, Hertford, silk-throwster,—"Improvements in spinning, doubling, and throwing organzine silk."—15th.

Timothy Hackworth and John Wesley Hackworth, Soho Works, Shilden, Durham, engineers,—"Improvements in locomotives and other engines."—15th.

Benjamin Fawcett, Old Jewry, builder,—"Improvements in pigments, paints, and vehicles for painting."—15th.

Isaac Lewis Pulvermacher, Vienna, engineer,—"Improvements in galvanic batteries, in electric telegraphs, and in electro-magnetic and magneto-electric machines."—15th.

Richard Hobson, Leeds, York, doctor of medicine,—"Certain improvements in the manufacture of horse-shoes, and in apparatus for taking the measurement of horse-shoes or horses' hoofs."—15th.

Edward Lyon Berthon, Fareham, Southampton, clerk, M.A.,—"Certain instruments for ascertaining and indicating the course or way, velocity, trim, and draught of ships, and the rate of currents; also, for discharging water from ships, and for taking altitudes and levels at sea and on land."—19th.

James Smith, Deanston, Perthshire, now residing in Glasgow,—"Certain improvements in treating the fleeces of sheep when on the animals."—19th.

William Ackroyd, Birkenshaw Mills, near Leeds, York,—"Improvements in dressing and cleaning worsted, and worsted mixed with cotton, and other fabrics, after they have been woven."—19th.

Warren de la Rue, Bunhill-row, manufacturer,—"Improvements in the manufacture of envelopes."—19th.

Frederick Hale Thomson, Berners-street, Oxford-street, Middlesex, and Edward Varnish, Kensington, same county,—"Improvements in the manufacture of inkstands, mustard-pots, and other vessels of glass."—19th.

Henry Fox Talbot, Laycock Abbey, Wilts, Esq., and Thomas Augustine Malone, Regent-street, photographer,—"Improvements in photography."—19th.

Joseph Whitworth, Manchester, engineer,—"Certain improvements in machinery or apparatus for cutting metals, and also improvements in machinery or apparatus applicable to agricultural and sanatory purposes."—19th.

Frederick George Spray, and George Nevett, Hampstead-road, engineers,—"An improved steam-engine, parts of the arrangements of which may be applied to apparatus for regulating, measuring, and registering the flow of liquids and gases."—21st.

Louis Cesaires Charpillon, Rue de Luxembourg, France,—"Improvements in locks for guns and pistols."—29th.

John Read, Park-terrace, King's-road, Chelsea, gentleman,—"Improvements in machinery for extracting fluids from animal, vegetable, and mineral substances, and in compressing the same."—29th.

William Palmer, Sutton-street, Clerkenwell, Middlesex, manufacturer,—"Improvements in the manufacture of candles, lamps, and wicks."—29th.

William Barlow, Blackheath, civil engineer, and William Henry Barlow, Derby, civil engineer,—"Improvements in the permanent ways of railways."—January 3d.

Albert Crackell Waterlow, London-wall, lithographer,—"Improvements in the means and apparatus for obtaining copies of writings, drawings, and other designs."—(Being a communication.)—3d.

Alexander Brodie Cochrane, jun., and Archibald Slate, Dudley, Worcester, engineer,—"Improvements in the manufacture of iron pipes or tubes."—3d.

Thomas Lightfoot, Broad Oak, within Accrington, Lancaster, chemist,—"Improvements in printing and dyeing fabrics of cotton and of other fibrous materials."—3d.

William Buckwell, Artificial Granite Works, Battersea, civil engineer,—"Improvements in compressing or solidifying fuel."—3d.—To extend to the colonies only.

Joe Sidebottom, Pendlebury, Lancaster, manager,—"Certain improvements in steam-engines."—3d.

Henry Dorning Hearsley, near Bolton, Lancaster, brick and tile manufacturer,—"Certain improvements in machinery or apparatus for manufacturing bricks, tiles, and other similar articles, from clay or other plastic materials."—3d.

David Blair White, Newcastle-upon-Tyne, doctor of medicine,—" An improved mode of ballasting and stowing cargo in ships and other vessels."—8th.

Matthew Urlwin Sears, Burton-crescent, St. Pancras, commission-agent,—" The improved construction of guns and cannons, and manufacture of cartridges for the loading or charging thereof."—11th.

Samuel Newington, Knole, Frant, Sussex, doctor of medicine,—" Improvements in sowing, manuring, and cultivating land, and in certain of the implements used therein." —11th.

Bennett Alfred Burton, of the firm of Bennett, Burton, and Burton, John's-place, Holland-street, Southwark, engineer,—" Certain improvements in apparatus connected with sewers, drains, and cesspools, also in suction and delivery pipes, and in connecting such pipes or hose—the apparatus connected with sewers, drains, and cesspools, being applicable to other like purposes."—11th.

John Fayrer, Surrey-street, Strand, commander in Her Majesty's Navy,—" Improvements in steering apparatus."—11th.

Alfred Cooper, Romsey, Hants, grocer,—" Improvements in steam and other power engines, and in the application thereof to motive purposes; also in the methods of, and machinery for, arresting or checking the progress of locomotive engines and other carriages." —11th.

James M'Donald, Chester, coachmaker,—" Certain improvements in the method of applying oil or grease to wheels and axles, and to machinery, and in connecting the springs of wheel carriages with the axles or axle-boxes."—11th.

John Glasgow, Manchester, engineer,—" Certain improvements in machinery or apparatus for shearing, shaping, punching, and compressing metals."—12th.

John Milwain, Manchester, joiner,—" Certain improvements applicable to the closing of doors, windows, and shutters."—12th.

Andrew Barclay, Kilmarnock, North Britain, engineer,—" Improvements in smelting of iron and other ores, and in the manufacture or working of iron and other metals, and in certain rotary engines and fans, machinery, or apparatus as connected therewith."—15th.

Richard Smith, Clitheroe, Lancaster, manufacturer,—" Certain improvements in looms for weaving."—17th.

Henry Cowing, Stamford-street, Blackfriars, gentleman,—" Improvements in obtaining motive power, and in steam and other ploughs, in land carriages, in fire-engines, in raising water, for draining and other agricultural purposes, and in apparatus for evaporating saccharine and other liquors."—17th.

Joseph Nye, Mill-pond Wharf, Park-road, Old Kent-road, engineer,—" Improvements in hydraulic machinery, parts of which machinery are applicable to steam-engines and machinery for driving piles."—17th.

William George Henry Taunton, Liverpool, Lancaster, civil engineer,—" Certain improvements in obtaining and applying motive power, and in a means to ascertain the strength of chains and ships' cables."—17th.

Robert Barbor, Chatham-place, Lock's Fields, Surrey, metal melter,—" Certain improvements in artificial fuel, and in machinery used for manufacturing the same."—17th.

IRISH PATENTS.

Sealed from 21*st December*, 1849, *to* 18*th January*, 1850.

Osgood Field, London, merchant,—" Improvements in anchors."—January 3d.

Peter Fairbairn, Leeds, York, machinist, and John Hetherington, Manchester, Lancaster, machinist,—" Certain improvements in machinery for preparing and spinning cotton, flax, and other fibrous substances."—12th.

Richard Hobson, Leeds, York, doctor of medicine,—" Certain improvements in the manufacture of horse-shoes, and in apparatus for taking the measurement of horse-shoes or horses' hoofs."—15th.

John Jordan, Liverpool, Lancaster, engineer,—" Certain improvements in the construction of ships and other vessels navigating on water."—17th.

Wenceslas Baron de Traux de Wardin, Liege, province of Liege, Belgium,—" Certain improvements in looms for weaving linen, woollen, and cotton cloths, and in the machinery for preparing the yarns for such cloths before entering the loom, and in a machine for finishing grey and bleached linen cloths."—17th.

Thomas Auchterlonie, Glasgow, manufacturer and calico printer,—" Improvements in the production of ornamental fabrics."—17th.

SCOTCH PATENTS.

Sealed from 22*d December*, 1849, *to* 22*d January*, 1850.

James Usher, Edinburgh, gentleman,—" Improvements in machinery for tilling land." —December 24th.

John Stoughton Christie, 13 Craven-street, Strand, Middlesex, Esq.,—" An improved construction of wrought-iron wheels, and machinery for effecting the same."—(Communication.)—24th.

Richard Hobson, M.D., Leeds, York,—" Certain improvements in the manufacture of horse-shoes, and in the apparatus for taking the measurement of horse-shoes or horses' hoofs."—26th.

William Ackroyd, Birkenshaw Mills, near Leeds, York, manufacturer,—" Improvements in dressing and cleaning worsted, and worsted mixed with cotton, and other fabrics, after they have been woven."—(Communication.)—31st.

John Barsham, Kingston, Surrey, manufacturer,—" Improvements in separating the cocoa fibre from cocoa-nut husks."—31st.

John Christophers, Heavitree, Devon, formerly merchant and ship-owner,—" Improvements in naval architecture."—31st.

Alexander Brodie Cochrane, jun., and Archibald Slate, both of Dudley, Worcester,— " Improvements in the manufacture of iron pipes or tubes."—31st.

Joseph Burch, Craig Works, near Macclesfield, engineer,—" Improvements in printing on cotton, woollen, silk, paper, and other fabrics and materials."—31st.

Winceslas Le Baron de Traux de Wardin, Liege, province of Liege, Belgium,—" Certain improvements in looms for weaving linen, woollen, and cotton cloths, and in machines for preparing the yarn for such cloths, before entering the loom, and in a machine for finishing grey and bleached linen cloths."—January 3d.

William Henry Wilding, New Road, Middlesex, gentleman,—" Certain improvements in engines and machinery for obtaining and applying motive power."—4th.

Charles Cowper, Southampton Buildings, Middlesex, patent agent,—" Improvements in machinery for raising and lowering weights and persons in mines, and in the arrangement and construction of steam-engines, employed to put in motion such machinery, part of which improvements are applicable to other useful purposes."—(Communication.)—4th.

Reuben Plant, Holly Hall Colliery, near Dudley, Worcester, coalmaster,—" Improvements in making wrought and bar iron."—7th.

Samuel Colt, Trafalgar Square, Middlesex, gentlemen,—" Improvements in fire-arms." —7th.

Thomas Lightfoot, Broadoak, within Accrington, Lancaster, chemist,—" Improvements in printing and dyeing fabrics of cotton, and of other fibrous materials."—7th.

Thomas Richardson, Newcastle-upon-Tyne, chemist,—" Improvements in the manufacture of Epsom and other magnesian salts; also, alum and sulphate of ammonia."—11th.

Jerome Andre Drieu, Manchester, machinist,—" Certain improvements in the manufacture of wearing apparel, and in the machinery or apparatus connected therewith." —14th.

Thomas Auchterlonie, Glasgow, manufacturer and calico printer,—" Improvements in the production of ornamental fabrics."—14th.

Andrew Barclay, Kilmarnock, Ayrshire, engineer,—" Improvements in the smelting of iron and other ores, and in the manufacture or working of iron and other metals, and in certain rotary engines and pans, machinery or apparatus as connected therewith."—14th.

Peter Armand, Le Comte de Fontainemoreau, 4 South-street, Finsbury, patent agent, —" Improvements in spinning fibrous substances."—(Communication.)—16th.

Joe Sidebottom, Pendlebury, Lancaster, manager,—" Improvements in steam-engines." —16th.

William Edward Newton, Office for Patents, 66 Chancery Lane, Middlesex, civil engineer,—" Certain improvements in pumps, and in machinery or apparatus for working the same, which latter improvements are also applicable for working other machinery." —(Communication.)—18th.

John George Barton, Regent's Park, Middlesex, gentleman,—" Certain improvements in printing and dyeing materials."—(Communication.)—21st.

Robert Wilson, Low Moor Iron Works, York, engineer,—" Improvements in steam-engine boilers, and methods of preventing accidents in working the same."—21st.

DESIGNS FOR ARTICLES OF UTILITY.

Registered from 12*th December*, 1849, *to* 17*th January*, 1850.

Dec. 13th,	No. 2119.	John Ambrose Coffey, Sydney-street, Commercial-road,—" Chemical apparatus."
14th,	2120.	William Wilson, Wandsworth Common,—" Beetle-trap."
15th,	2121.	Thomas Key, Charing-cross,—" Double-keyed slide trombone."
—	2122.	John Remington, Shaftsbury-crescent, Pimlico,—" Balcony fire-escape."
18th,	2123.	Isaac Whitesmith, Rose-street, Glasgow,—" Spindle and flyer."
—	2124.	George Rush, Elsenham Hall, Essex,—" Dials for the aneroid barometer."
19th,	2125.	George Clark Rout, Portsmouth,—" Riding trousers."
—	2126.	John Mayes, St. John-square,—" Razor strop."
—	2127.	Joseph Dawson, Islington,—" Cravat."
22d,	2128.	Bathgate and Wilson, Canning Foundry, Liverpool,—" Metallic cask or vessel."
27th,	2129.	John Meik and Henry Watson, Sunderland,—" Signal-house."
28th,	2130.	Augustus Smith, Osborne-street, Whitechapel,—" Universal painters' brush."
—	2131.	Westley Richards, Birmingham,—" Cork-screw."
—	2132.	William Gordon, Army and Navy Club, St. James'-square, London, lieutenant, R.N.,—" A pair of marine steam-engines."
1850. Jan. 2d,	2133.	John Lart and Son, Wood-street, Cheapside,—" Elastic back-piece for cotton and other drawers."
4th,	2134.	John Wilson, Manchester,—" Elastic riding belt."
—	2135.	Henry Stephenson, Howley-street, Lambeth,—" Atmospheric churn dasher."
5th,	2136.	Henry Moore Naylor, Birmingham,—" Hook and eye."
7th,	2137.	Edwin Kesterton, Long-acre,—" Carriage (the Akolaston)."
—	2138.	Deane, Dray, and Deane, King William-street,—" Gas stove."
8th,	2439.	George Church, Clifton, Bristol,—" Wrist supporter for facilitating the practice of the piano-forte, organ, or seraphine."
—	2140.	Richard Townly, Cursitor-street, London,—" Plat or plait."
9th,	2141.	John Cornes, Carrow Works, Norwich,—" Dressing machine."
—	2142.	Edward Grey Williams, Liverpool,—" Screen and smut machine."
—	2143.	Peter Hunter Irvin, Hope-terrace, Nottingham,—" Portable wash-hand stand and dressing-case."
10th,	2144.	James Parkes and Son, Birmingham,—" Rule."
—	2145.	Williams and Son, Birmingham,—" Snuff-box."
—	2146.	Myer Myers, Birmingham,—" Pen-holder."
11th,	2147.	George Cubitt, North Walsham,—" Hand power for winnowing, threshing, and chaff-cutting machines."
14th,	2148.	William Henry Muggleton, Tottenham,—" A type frame."
—	2149.	Louis R. Bodmer, Manchester,—" Door-spring."
—	2150.	Westhead and Co., Manchester,—" The respirator cravat or fog repellant."
16th,	2151.	Blackburn and Higgin, Bethnal Green-road,—" Fronted vest for gentlemen and ladies."
—	2152.	George Jacobs, Cockspur-street,—" Fan riding-whip."

TO READERS AND CORRESPONDENTS.

We have to announce that our office is now at 166 Buchanan Street, where, in future, all communications for the *Practical Mechanic's Journal*, or for the *Office for Patents*, must be addressed.

M'DONALD'S WOOD PLANING MACHINE.—We give the first plate of this machine this month; the second, with the description, will follow in the March number.

ERRATA.—American Engineering, Chinese Mechanism, and First Notions on Political Economy.—The foot-note on the first column of page 219 of our last number, is a superfluous one, as the two figures in question were given at the time. That on the following page refers to the figure now given as a supplement to the article. In the article Chinese Mechanism, at page 226, the route of the buffaloes in figs. 2, 3, and 8, is the reverse of that described in the text. This has arisen from the fact of the draughtsman having neglected to reverse the drawings in transferring them to the wood. The same disagreement occurs in reference to the Chinese figure in fig. 5, that gentleman being delineated as in the act of blowing the fire with his left hand, instead of with his right. In First Notions of Political Economy, page 224, col. 1, line 18, for "impervious," read "imperious." In Roberts' Signal for Railway Trains, page 233, last line but one, for "my," read "any."

J. C., Glasgow.—His notes on the Britannia Bridge were received too late for use this month. His sketches are now being engraved for the next number.

Dr. W., Beds.—We have examined and transmitted the communication.

W. A. T., Engineer.—Apply to Mr. Davenport, at the Society's house, John Street, Adelphi. He will give all particulars. It is by no means necessary to be a member of "the profession."

J. W., London.—It is a pity the query was not originally stated correctly. If we could oblige him, without an objectionable recapitulation, we should be glad to do so.

J. C., Birmingham.—A press of other matter has prevented the insertion of a notice we had written in the matter of the ellipse. It shall have a place next month, along with his letter.

T. S., Cornwall.—The preceding answer will apply to this correspondent. The sketch is in the engraver's hands.

W. J. S., London.—If he distils together 1 lb. of chloride of lime, 3 lb. of water, and 3 oz. of alcohol, in a capacious retort, he will pass over about 3 oz. of chloroform. For *Perchloride*, as printed last month, read *Terchloride*.

MATTER AND ITS PROPERTIES.

Between the mind of man and the external world, the senses form a channel of communication, and numerous and diversified relations become thus established between them. Everything which is capable of yielding an impression through the senses is termed matter, and the feeling excited when such an impression is conveyed, is termed a sensation. What mind and what matter are in themselves, and what is the mode of action of the latter upon the former, are not within our purpose to inquire. It is sufficient to remark, that matter is so formed, that it produces impressions essentially distinct from each other, when it excites the several sensations of touch, sight, hearing, taste, and smell, and that the phenomena which act upon the three first, can be defined and analysed, if not directly, at least by some of their effects, so that we can measure and compare their causes. As yet we have no accurate means of comparing the sensations arising from smell and taste; and, therefore, the phenomena connected with them are still without the domain of science in its present condition.

Amongst the different modes of material action, some address themselves only to one sense,—such are the sensations of heat to the touch, sound to the hearing, light to the eye. Electricity acts principally on the touch, in causing shocks, sometimes so violent that they occasion instant death; but it also produces noise, light, savour, and even a peculiar smell. Now, whatever may be the manner in which these different properties of matter directly operate upon our senses, they indirectly produce effects which it is possible to define and measure. It is solely under this view that physical philosophy regards heat, electricity, sound, light, &c., and forms out of the sensations thence arising, so many different branches of sience.

It is a leading axiom of science, that matter is indestructible. Material substances are liable to infinite changes, but these only affect their form. Amidst them all, not one particle has been annihilated. Solids become fluids, fluids gases, and gases can be solidified. In those cases where there is an apparent destruction of matter, it can be proved that a new arrangement of its particles has taken place, and in many instances every one of those particles can be traced through its various transformations to its ultimate destination. Chemistry affords a thousand beautiful examples of complete change in the forms of matter. A familiar instance may be found in the combustion of a candle. The tallow being melted, is drawn into the wick, and there volatized by heat—the vapour being raised to such a temperature, that a rapid combination with the oxygen of the atmosphere is formed, and the heat evolved is sufficient to heat the vapour to whiteness. The solid matter is thus chemically changed, and disappears in the shape of gas.

It is not difficult to discover that the greater part of the properties of matter are accidental, that is, such as we can abstract from our contemplation, and preserve the notion of a material body. But there are at least two properties which must be regarded as essential, viz., magnitude and impenetrability.

Every body, wherever it may be, occupies a certain portion of space, and is included by certain limits, the disposition of which determines its configuration. The space included by these limits is termed the size, magnitude, or extension of that body. The term impenetrability, signifies the absolute impossibility of making two distinct bodies occupy the same portion of space at the same time. It is evident that the mind is equally incapable of conceiving a body which has not some magnitude, or one which, without quitting its place, will permit another body to occupy the same place with itself. It follows, that magnitude and impenetrability are two essential properties of matter.

A distinction must be made between the magnitude and the figure of a body; in other words, between its size and its shape. Bodies having the same magnitude may have different figures; for instance, a pyramid may be constructed so as to have precisely the same solid contents as a cube; and bodies having the same figures may have different magnitudes, as the planets are all oblate spheroids of various sizes.

Divisibility is the property which every grain of matter possesses of separation into parts, and as the mind absolutely refuses to conceive any body so small that it cannot be divided into parts, or any part so minute that it cannot be subdivided, this property has no limit. The smallness of the parts into which a body can really be reduced, is sometimes very astonishing. An ounce of gold can be beaten so thin, that it will cover 146 square feet. Dr. Wollaston succeeded in making platinum wire which did not exceed the 18,000th of an inch in diameter. It would take more than 109,000 yards of such wire to make a coin the size of a franc piece; and a cube of solid metal, the size of a common gaming die, might be extended from London to Edinburgh and back again. In manufacturing embroidery, gilt silver threads of a high degree of fineness are required. To obtain them, a cylindrical bar of silver, weighing 360 oz., is covered with two oz. of gold. The bar is then drawn into wire, which is flattened by pressure between rollers, until 4000 feet of it weigh no more than an ounce; consequently, the gold upon one foot of such wire, will weigh about the 720,000th of an oz. Taking an inch of the wire, and subdiving it into a hundred parts, the eye will see on that portion of a hundredth part which will be turned towards it, a film of gold, weighing only the 1,728th million of an ounce. And if such a part be viewed by a microscope, magnifying 500 times, a portion of surface, the 250,000th of that previously under consideration, can be seen, the gold upon which is, in point of minuteness, beyond conception. Yet the silver within can be removed by acid, and the gold will be left in the form of a tube. A fine human hair is the 600th part of an inch in thickness; the silkworm's thread is about the 2000th part of an inch thick; the spider's thread is sometimes not more than the 30,000th part of an inch thick, and each thread is composed of four or six smaller threads. Each of these smaller threads is formed by uniting streams of viscid fluid that are pressed out of at least 1000 apertures in the hinder part of the creature. A fibre of flax is a combination of fibres, measuring about the 2,500th part of an inch in thickness. The matter which gives blood its red colour is in the form of minute discs, floating in a fluid termed serum. A drop of human blood hanging from the point of a needle will contain a million of these discs. The red discs in the blood of the musk deer are still less, and a drop of its blood of similar size will contain three millions. Soap bubbles are commonly less than the 25,000th part of an inch in thickness, and this becomes reduced to the four millionth of an inch, when a black spot appears at the top just before bursting. A hundred thousand wings of certain insects placed one upon another, would only measure an inch. The microscope, in the hands of skilful observers, discloses organic bodies of extraordinary minuteness. Ehrenberg states that the fossil shell of the gallionella, which composes a slaty deposit 14 feet in thickness at Bilin, in Germany, is so small, that forty thousand millions would occupy no more than a cubic inch, at which rate 182 millions would weigh no more than a single grain. The enclosed animal must, of course, have been less than its shell, and when we consider the organs of this animalcule, its mouth, eyes, and enclosing skin, and then the particles of matter composing these parts, the mind is bewildered in its efforts to conceive such diminutive portions of space as these organs and their constituent parts must fill. Ehrenberg says that the gallionellæ have such a prodigious power of increase, that in four days an animalcule, invisible to the naked eye, would form a mass of matter equal to two cubic feet of the Bilin polishing slate. The animalcules of iron ochre are still more minute; being no more than the 12,000th part of an inch in diameter, a cubic inch would contain two million millions. Chemistry furnishes us with many examples of the very minute division to which solid matter can be brought by diffusing it through a fluid, and we have evidence that the particles of matter which occasion the sensation of smell must be extremely small. A grain of musk has been known to scent a large room for twenty years, and still to appear no less than at first.

Porosity is that property in bodies which consists in the small particles composing them, being separated by intervals, vacancies, or pores. Even when this property is beyond our power of vision to detect, there is reason to believe that it is present—so that the component particles are to be considered as never in actual contact on all their sides for the greater part of their surfaces, but divided from one another by interstitial spaces. There is a mineral called hydrophane, which, in its ordinary state, is only translucent, but, being placed in water, bubbles of air escape from it, and the stone becomes as transparent as glass, a consequence of the water entering and filling its pores. A scientific academy at Florence having completely filled a hollow sphere of gold with water, submitted it to pressure, until it became flattened. The water was forced through the pores of the metal, and came out like dew on the exterior surface of the sphere. Since bodies possess porosity in various degrees, they may, under similar volumes, contain different quantities of matter. By density is meant the proportion of the quantity of matter, or the mass, to the magnitude; and a body is said to be dense, in comparison with another body of the same magnitude, when it contains more matter. It is evident that density and porosity are the opposites of each other.

The properties connected with changes of the size or volume of bodies are compressibility, elasticity, and dilatability. Compressibility—that is, the capability in bodies of suffering a reduction of dimension without having their mass diminished—is evidence of their porosity. Elasticity is the power of recovering their former dimensions, when the force which compressed them is removed. There are many bodies which are compressible without being elastic, but all bodies which are elastic must be compressible. When bodies, in returning to their original dimensions, exert a force equal to that which compressed them, they are said to be perfectly elastic, and this property is possessed by aeriform bodies. Some degree of elasticity is possessed by nearly all solid bodies, but there is great difference amongst bodies as to the extent of the property. It exists in a wire of lead, and in a cylinder of pipe-clay, although lead and clay are usually ranked amongst non-elastic bodies. The elasticity of metals is most clearly seen when they are in the shape of wire. When bodies have been strained beyond their power to recover themselves, they receive a permanent alteration in shape, or take a new *set*, as it is called. Of course this alteration takes place with a degree of compression which bears an inverse ratio to the degree of the elasticity in a body; but after a permanent change in shape, the body will have the same elastic power as it had before. Thus, a piece of lead wire which has received a new *set* by twisting it beyond its elastic power, will continue in its new position, to enjoy the same degree of elasticity that it previously had. Liquids are compressible in a very slight degree. An accurate experimentalist found that a pressure of 15 lbs. to the square inch reduced the bulk of water by a 46th millionth part. Many of the most important functions of bodies depend upon their elasticity. For instance, the organ of hearing is framed with reference to the elasticity of sonorous bodies, and of the media appropriate for the conveyance of sound: if these bodies and media were deprived of elasticity, no sound would ever reach our ears. If air were non-elastic, there would be no wind; it would be entirely unfitted for the respiratory organs, and in consequence of the stagnant character of the atmospheric ocean, wherever man was congregated, would be the seat of disease and death. If water were non-elastic, the sea would be almost unnavigable; it would be without waves, and the animal life it contains could no longer exist in their present shape. Dilatability is the quality which some bodies have of enlarging their volume without increasing their mass. Heat is a great agent in the dilatation of bodies—a process it effects by introducing a repulsive force amongst the particles.

Ductility is the property possessed by several of the metals, resulting from their tenacity of being elongated into narrow threads, or drawn into wire. The following is the order of the ductility of the principal metals:—gold, silver, platinum, iron, copper, zinc, tin, and lead. It is a singular fact, that although the metallic particles are less compact after being drawn into wire than before, yet they have a greater tenacity. That of lead is three times greater, but that of iron is increased to a much higher degree. A cable of fine iron wire—each wire having a diameter of the 20th of an inch, and the whole cable containing as much iron as a solid bar one inch square—will sustain a weight of from 60 to 80 tons. Cables of iron wire have lately been much used in the construction of suspension bridges, in consequence of their ability to sustain a powerful strain without breaking.

Malleability is the capacity of being extended into thin plates by means of blows or pressure. The principal metals are malleable in the following order:—gold, silver, copper, tin, platinum, lead, zinc, iron. Metals are usually rendered more malleable by heat. Zinc, which, when cold, refuses to expand under the hammer, can be rolled into sheets at a temperature a little above boiling water, but, if subjected to a heat of 400°, it becomes extremely brittle.

There are certain forces, bearing the common name of Attraction, which are found in operation throughout the whole of the material world. That species of attraction, which is seen at work on a grand scale amongst the planetary spheres, and between the earth and objects on its surface, is termed the attraction of gravitation. An instance of attraction is seen every time that a body falls to the ground.

Attraction of every kind decreases in intensity as the space separating bodies is increased. The law of such decrease is, that *the attracting force is inversely as the square of the distance* between the portions of matter subjected to its influence—a law which will be better understood after glancing at the following table. We will suppose two bodies, when at a distance of one foot, to attract each other with a force equal to 1, then at two feet they will attract each other with only a fourth of that force, at three feet with only a ninth, and so on, the squares of the distance always representing the rates at which the force diminishes.

Distance,....................	1	2	3	4	5	6	7	8	9	10
Intensity of attraction,.....	1,	$\frac{1}{4}$,	$\frac{1}{9}$,	$\frac{1}{16}$,	$\frac{1}{25}$,	$\frac{1}{36}$,	$\frac{1}{49}$,	$\frac{1}{64}$,	$\frac{1}{81}$,	$\frac{1}{100}$.

We postpone for the present, however, entering upon the subject of gravitation, and shall direct out attention to that other species of attraction which causes material particles to cling together with more or less tenacity, so as to form masses of greater or less size, and which is called molecular attraction. Though its operation is confined within narrow limits in point of distance, it plays a most important part in the structure of the world, for it is highly probable that we ought to attribute to it, along with the antagonistic force of caloric, the elasticity, ductility, hardness, and tenacity of bodies.

1. If we let a little mercury fall upon a flat surface, such as a clean glass plate, it will break into a number of parts, the globularity of which will be in proportion to their minuteness. This configuration, a consequence of the mutual attraction of the particles, and of great mobility, would likewise show itself in the entire quantity if it were unaffected by other influences. Gravity, however, and the attraction of the substance on which the mercury rests, overcome the molecular attraction to such an extent as to flatten it at the top and bottom, and destroy its sphericity.

2. If we bring the scattered globules of mercury into contact upon the glass plate, they will be seen to unite the moment they touch.

3. Other liquids do not so readily exhibit the same tendencies as those described, the reason being, that the mutual attraction of their particles is not strong enough to counterbalance the action of gravity, and the attraction of the substance on which they are deposited. Thus a drop of water or oil, falling upon a table of wood or marble, becomes flattened, and spreads out into a circle slightly elevated in the middle. But if the table be previously covered with a thin layer of dust, or if the large leaves of certain plants be used, its attracting influence disappears, and the liquid, preserving its globular form, rolls along the surface.

4. The attraction which solid bodies exercise over each other, and over liquids, may be shown by pressing together two discs of glass, which will be found to adhere the more strongly as the points of their contact are more numerous. The same thing will occur from the contact of two pieces of marble and metal. A disc of glass suspended from one of the scales of the hydrostatic balance, and maintained in equilibrium by a weight in the opposite scale, will be found to adhere to the surface of a liquid, with which its lower face may be brought into contact, with a force which varies with the nature of the liquid, and the diameter of the disc.

The attraction we have described is termed the attraction of cohesion, when it takes place between particles of the same kind (homogeneous); and the attraction of adhesion, when the particles in which it operates are of a different kind (heterogeneous).

There is another species of attraction, named capillary attraction, or capillarity, which modifies the laws of cohesion and gravitation in a curious manner. If tubes of very fine bore—(hence called capillary tubes, from *capillas*, a hair)—have their ends placed in water, the liquid will rise in them to a height above the level of the exterior water. The smaller the bore of the tube, the higher the water will rise in it. But this species of attraction is not confined to tubes; for if a sheet of glass or metal is immersed in any liquid capable of wetting it, the liquid will rise in a curved line against each side of the glass or metal sheet. Repulsion, on the contrary, will occur in case the fluid is incapable of moistening the substance plunged into it—as, for example, place a plate of glass in mercury, and a depression of the mercury will be observed on each side of the glass. The summit of a column of liquid inside a tube is not level, but takes the form of the curve called a meniscus, being higher at the sides, where the attraction between the tube and the liquid is more powerful than in the middle. In most animal and vegetable organs, the structure resembles in effect a bundle of capillary tubes, from the small spaces which exist between the parts. It is this kind of attraction which causes sap to climb the upright stems of plants, oil to ascend in lamp wicks, water to be drawn up into a sponge, and liquid to run through a piece of sugar.

The phenomena of *endosmose* and *exosmose* are probably caused, in the first instance, by the mutual attraction of two fluids, but they would seem to be effected by means of capillary attraction. When two liquids of different densities, capable of mixing with each other, are separated by a membranous partition, such as a piece of bladder, currents take place through the membrane in opposite directions, until a mixture of the two liquids is effected. Fluids of less specific gravity have a stronger tendency to penetrate, and will therefore pass through more rapidly than fluids of greater specific gravity. Thus, let a solution of gum be placed in a piece of animal membrane, shaped like a bag, and tied to the end of a tube. When this bag is immersed in water, the latter will penetrate into the bag at a quicker rate than the dissolved gum issues out. The contents of the bag will consequently increase in bulk, and will be seen to rise in the tube, so that the level of the denser liquid will be above that of the exterior water. Vegetable membranes and some mineral substances also exhibit analogous phenomena, and gases, as well as liquids, are found to permeate them.

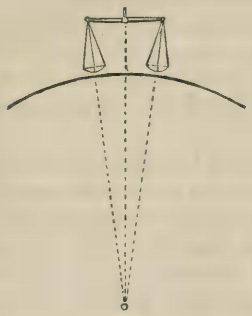
That form of attraction, which has been called the attraction of gravitation, is found to exist not only on our globe, but wherever there is matter which we are able to bring within the reach of our examination. It is an operation amongst the bodies composing our solar system, and there is every reason to believe that the most distant stars are subject to its influence. Its laws may be briefly summed up thus:—Its influence is mutually exerted and felt, (if A acts upon B, B also acts upon A); that the force with which any body (A) attracts another body (B), is in the proportion of the mass of A to the mass of B, (*e. g.* A having twice the mass of B will attract B with twice the force that B exerts upon A); and that the force with which bodies are drawn together decreases in intensity by increasing the distance between them, so that the square of the distance represents the rate of diminution. The rotundity of the earth is a consequence of this force, because all the particles are attracted to one common centre, and about this centre they arrange themselves, so as to preserve the equilibrium of the whole.

We give the name of gravity to the attraction which the earth exerts upon bodies at its surface, and which causes them to descend when left without support. In common language, they are said to fall; in philosophical language, they are said to be attracted by the mass of the earth. Since the force of attraction is in proportion to the attracting mass, we may infer that it does not merely affect the surfaces of bodies, but is exerted by, and penetrates to, all the interior particles. Again, since the degree of force which one body exerts upon another is shown by the space over which the latter is compelled by the former to move, we may infer, that, although there is a reciprocal attraction between a falling body and the earth, yet the latter, by reason of the overwhelming proportion of its mass, is not sensibly drawn out of its place, and thus all the motion seems to belong to the falling body. Those cases in which we see a body *ascend*—for instance, a balloon in the air, a piece of cork from the bottom of a quantity of water to the top—are not to be considered exceptions to the universal law of gravity; the fact being, that the surrounding fluid is heavier, *i.e.* more strongly attracted, than the balloon and the cork, and that, in descending, it pushes these bodies upwards.

The direction of the gravitating force is towards the centre of the earth. Since the earth's figure is an oblate spheroid, with a less space between the surface and the centre at the poles than at the equator, the intensity of gravity gradually decreases as we proceed from either pole to the equator. Moreover, it diminishes as we mount above the level of the sea.

Its direction is well represented by a plumb-line at rest, or by a line drawn perpendicularly to a sheet of still water. This direction is termed vertical at the particular spot under consideration, and the plane perpendicular to it is termed the horizontal plane. Rigorously speaking, since the globe is a sphere, no two points on its surface are in the same horizontal plane, and, consequently, the vertical lines representing the directions of gravity at different places are not parallel to each other. Thus, even the scales, separated only by a small beam (fig. 1), will be inclined at some slight angle to each other. But in considering small distances, two verticals may be taken to be parallels without sensible error.

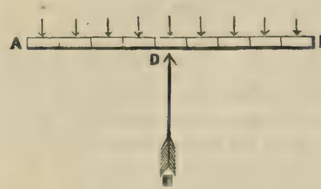
Fig. 1.



What we term the weight of bodies, is the effect of the earth's attraction upon them; and the mode of ascertaining such weight is by comparing the force of the attraction exerted upon any given body with the force exerted upon some other body, which we take as a standard. The weights of bodies at the same place are, of course, proportional to the number of particles respectively composing them—that is, to their masses or quantities of matter. Referring to what has been said before, it will be seen why, although the mass of a body remains the same, its weight is less at the equator than at the poles—less at the top of a high mountain than on the plains at its feet. We must carefully distinguish between gravity and weight. The former signifies the cause of bodies being drawn towards the earth; the latter expresses the particular force influencing them at a particular place.

Centre of Gravity.—In order to retain in a state of rest, any particle of matter left freely to the action of the gravitating force, it is evident that we must oppose that force by another of equal intensity directed vertically upwards. If we substitute for the single particle a collection of particles joined together, nothing more will be necessary for a similar end than to apply, in like manner to each, that amount of force which is required for counterpoising the action of gravity in each. We may substitute for these several opposing forces a single vertical force, equal to their sum, and applied to one point, termed the centre of gravity. This point may be defined as that through which passes the resultant of the parallel forces, exerted by gravity upon the whole of the particles of a solid body. The simplest instance that can be adduced, is that of a collection of particles arranged in a line, so as to form an homogeneous beam or bar (fig. 2). If we oppose to the forces acting vertically downwards upon each particle of the bar, A B, another force equal to their sum acting in a contrary direction, C D, we shall find, on shifting such force from A towards B, a point, D, such, that not only will the bar assume a state of repose when the force, C D, is applied to the point, but if moved from that state for a moment by some external force, it will immediately return to it. The point, D, in the centre of the bar is, then, the centre of gravity, or centre of parallel forces, of that bar.

Fig. 2.



The discovery of the centre of gravity in bodies of a regular figure is a simple operation, assuming them to be homogeneous—that is, composed of particles equally distributed. Thus, the centre of gravity of the area of a triangle is at the point of intersection of three lines drawn from the vertices of the angles to the centres of the opposite sides. That of a parallelogram is the point where lines bisect which connect the middles of opposite sides. The centre of gravity of a triangular pyramid is at the point of intersection of lines connecting the vertices of the four angles with the centre of gravity of the opposite bases. The centre of gravity of a pyramid with any plane base whatsoever, or of a cone, is one-fourth of the way up the line joining the centre of gravity of the base with the vortex. That of a paraboloid is at one-third of its height; and that of a hemisphere, or hemispheroid, at three-eighths.

The centres of gravity of a polygon, or of a polyhedron, may be deduced from the preceding, since a polygon can always be resolved into triangles, and a polyhedron into pyramids. For more complicated figures the infinitesimal calculus must be used. But the centre of gravity of a moveable body can be always found experimentally, by suspending it freely from two different points. Vertical lines drawn from those points will intersect at the centre of gravity.

The centre of gravity is not necessarily in the body itself; for instance, that of a ring, or an empty vessel, is at a point lying in vacant space.

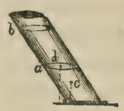
A suspended body, or one which rests upon a horizontal support, cannot be in a state of repose unless the vertical line, which passes through its centre of gravity, also passes through the point of suspension, or the point of support. Hence result several considerations relative to the position of the equilibrium of bodies. The position may be *stable*, *unstable*, or *indifferent*. It is stable when the body, having been removed from it, returns to it of itself; for example, a plumb-line, being drawn out of the perpendicular, will, on being left at liberty, return to that position after a certain number of oscillations. A cane supported in the air on the tip of the finger is an instance of unstable equilibrium. But if we are at the pains to oppose, by moving the finger, the various motions which the oscillations of the centre of gravity impress upon the cane, we may contrive to keep it in nearly vertical positions. An homogeneous sphere, with a smooth surface, placed upon a perfectly level plane, is indifferent, since it remains at rest, whatever point of its surface touches the plane.

It is always advisable to place the centre of gravity in a body as low down as possible, with a view to the preservation of its equilibrium, for this reason, that the point will then have further to travel before it overhangs its base, and will therefore require a greater force to upset it. Attention ought to be paid to this principle in the building and loading of carts, carriages, &c. The broader the base, and the nearer the vertical line from the centre of gravity approaches to the centre of that base, the more firm will be the position of a body.

The famous tower at Pisa, 182 feet high, is 16 feet out of the perpendicular; and at Caerphilly Castle, South Wales, there is a tower only 80 feet high, which is 11 feet out of an upright position. There are two towers at Bologna (one of them called Asinelli, 320 feet high), which also lean to one side. But as long as the centres of gravity of these towers are supported by their bases they will not fall.

A single experiment will illustrate the principle. Take a cylindrical glass, of the shape represented in fig. 3, and fill it with water up to *a*. The centre of gravity will then be at the point, *c*, and its vertical is supported by the base; but pour in more water as far as *b*, and the centre of gravity will be removed to *d*—the vertical falling without the base, the glass will topple over.

Fig. 3.



In the postures and movements of animals, we see them place the centre of gravity of their bodies so as to receive support. When a man stands upright, the vertical passing through his centre of gravity must fall within the base formed by his feet. Theory, as well as experience, proves that in proportion as the feet are separated from one another, their direction must be more parallel in order to secure the greatest stability. In walking, or in standing upright, the position of the toes turned out is as conformable to the laws of mechanics as it is agreeable to the eye. A man with a burden on his shoulder must bend forward—one bearing a pail of water with one hand must lean to the other side—whilst a nurse carrying a child in her arms must lean backwards—and a person with a pitcher of water on his head must hold himself as straight as possible, in order that they may respectively place the centre of gravity in the best position with a view to support. When we climb a hill, we bend the body forwards; when we descend, we incline it in the other direction, with the view of keeping the vertical line of the centre of gravity within the base formed by the points of support. A number of toys have been constructed, the amusement of which depends on the ingenious disposition of their centres of gravity; and the difficulties of performing feats of posturing, dancing on ropes, balancing poles upon the chin, &c., arise from the necessity of constantly discovering the centre of gravity in new positions.

In calculating the surfaces and solid contents of what are termed solids of revolution—(solids, that is, capable of being formed by the revolution of a line round a fixed axis, such as a sphere and a cone)—the centre of gravity of the plane figure, formed by the revolving line and the axis of revolution, may be usefully employed, from its possessing a remarkable geometrical property. 1. The area of the surface of the solid may be found by multiplying the length of the generating line by the path described by the centre of gravity of the plane figure supposed to revolve along with the line. 2. The volume of the solid may be found by multiplying the area of the plane figure, formed by the revolving line and its axis of revolution, into the length of the path described by the centre of gravity of the plane figure. This theorem is known as the Centrobaryc, or Guldinus' theorem, though it is to be found in the Mathematical Collections of Pappus, the Alexandrian geometer, who flourished in the fourth century of our era.

The specific weight or gravity of a body is the relation of its weight to its volume. The mode of ascertaining the specific gravity of a solid is to learn its weight in the air by weighing it in a delicate pair of scales; and then, suspending it from the hook placed at the centre of one of the scales of the hydrostatic balance, to let it hang in distilled water at the temperature of 62°, and again take its weight. According to the principle of Archimedes, it will, in this situation, displace a volume of water equal to its own volume, and its weight will be diminished by the weight of the water displaced. Having thus obtained a knowledge of the proper weight of the body, and the weight of a volume of water equal to the volume of that body, we have the means of ascertaining the difference of the weights of water and the body, bulk for bulk. A cubic foot of distilled water at 62° weighs nearly 1000 oz. avoirdupois, or exactly 997·1369 oz., and a cubic inch 252·458 grains. Water of this temperature is taken as a standard, and is represented by unity 1·00. Consequently, the number of times by which the weight of a body exceeds the weight of a similar volume of water, represents the specific gravity of the body. Thus, a piece of gold weighing 154 grains, when weighed in water is found to lose 8 grains. Eight grains, then, is the weight of an equal bulk of water. Now, $154 \div 8 = 19\frac{1}{4}$, or 19·25—that is, gold is $19\frac{1}{4}$ times heavier than water.

When the substance whose specific gravity is sought is lighter than water, it is made to sink by being connected with a body whose specific gravity is known; and the same process being gone through by a little further calculation, the desired result is obtained. When the substance is soluble in water, we must substitute some other liquid whose specific gravity has been ascertained. The figures obtained by this process being multiplied by the specific gravity of the liquid, will give the specific gravity of the substance. As to fluids, the readiest method of ascertaining their specific gravities is to compare the weights of equal quantities of them and of water. But instruments called areometers, or hydrometers, are frequently used for this purpose, the principle of which depends on the fact of solids of a given weight sinking deeper in light fluids than in those of greater density. With respect to gases, atmospheric air is taken as the standard of comparison. A glass or metal flask is weighed first when full of common air, and again when exhausted. Being then charged with the gas, whose weight is sought, the difference of weight between the two is easily obtained.

A knowledge of the specific gravities of bodies furnishes naturalists with a means of distinguishing certain matters having similar external properties from one another. It affords chemists the means of solving a variety of important problems; and, in the arts and commercial dealings, it serves to fix the degrees of concentration or rectification to which certain liquids must be submitted, either to render them suitable for particular operations, or to give them a determinate value.

PRACTICAL GEOMETRY.

ON THE METHOD OF DESCRIBING AN ELLIPSE.

The following letter will be found worthy of a careful perusal, more particularly by those who have read our previous article on the same subject. We are at all times ready to open our pages to the thinking class of readers, and are quite willing to learn from any of them; but we may, in the present case, remark, that we were aware of the defect so clearly removed by Mr. Crane, and it is to be attributed to mere accident that we did not say of our first problem what we said of the second—that "this is merely an empirical rule."

The only claim to novelty rests on the method of finding the large circles when the position of the focal centres has been determined. In practice, we must confess, we should at once fix them by our unaided judgment, and we think most draughtsmen would do the same; but when a very close approximation, and one reducible to rule, is required, we know of no better one than that given in the present article. The other centres may be found by the method described in our previous paper, which method appears to have been independently adopted by our correspondent, "D."

Before remarking upon the article under this head in your December part, I would observe that I am not in the habit of "finding fault with what cannot be improved;" therefore, in giving you my objections to D.'s rule, I shall show how those objections may be removed. It is as essential to the pattern-maker as to the draughtsman to know how to form a true ellipse to any given dimensions, and there are more methods than one by which the figure may be correctly drawn, such as the string and marker movement; but this, and similar practical methods, are not always available, and the draughtsman is consequently compelled to use other means.

Any trifling inaccuracy may, in metal and wood, be corrected, and they may be—and often are—worked down to a correct form; but this convenience is denied to him who wishes to draw an ellipse upon paper. He cannot use the pins and string in many cases, and therefore is compelled to use elliptical compasses, or elliptographs, which are troublesome and often inaccurate instruments. Rather than do this, he is often content with describing very queer figures indeed, with his compasses—calling them ovals—heartily wishing within himself that his compasses knew how to describe a true ellipse. Any rule, therefore, by which this can be done, will be hailed as a great boon by all who have occasion to draw ellipses. The article, before referred to, purported to give this information, into the merits of which I shall now inquire, taking as my encouragement the concluding sentence of your first paragraph, which is—"Those who are already well-informed, will have their attention drawn to the problem; and if in possession of superior knowledge, we trust they will not leave their less fortunate companions in ignorance, but will avail themselves of our pages to diffuse their information."

I need not transcribe your article into this paper, but will refer you to the original, whenever necessary. It contains two solutions of the problem—to describe an ellipse with ordinary compasses—one by W. Templeton, which I shall term T.'s, and the other by yourself, I presume, which I will call D.'s. In the examples given, both appear correct; but I will prove that neither of them is so, except in one case each. By applying compasses to any true ellipse, it will be seen that certain parts of the curve approach very near to arcs of circles, and that these parts are about the vertices of its two axes; and by the nature of an ellipse, the curve on each side of either axis is equal and similar; consequently, if arcs of circles be drawn through all the vertices, meeting one another in four points, the opposite arcs being equal and similar, the resulting figure will be indefinitely near an ellipse. Four circles, described from four different points, but with only two different radii, are then required. These four points may be all within the figure—the centres of the two greater circles may either be within or without; but the centres of the two circles at the extremities of the major axis must always be within, and, consequently, the whole four points can never be without the figure. Again, the proportions of the major and minor axes may vary infinitely, but they can never be equal; therefore, any rule for describing ellipses must suit all possible proportions, or it does not possess the necessary requirements. Moreover, if any rule apply to one certain proportion and not to another, it is evident that the more the proportions differ from that one—whether *crescendo* or *diminuendo*—the greater will be the difference of the result from the true one. From this it follows, that if a rule applies not to all, it can only apply to one proportion; and also, that if it apply to a certain proportion and not to another, it can only be correct in that one case. If, then, T.'s rule be correct, it should apply to all possible proportions of the major and minor axes. Let the proportion be as 3 to 1; then marking off A *b* equal to C *o*, the remainder, *b o*, is equal to 2 C *o*, making *c o* equal to *b o*, and bisecting *b c*, its half, *b d*, will be greater than half *b o*, that is A *e*; and, consequently, when *b e* is marked off equal to *b d*, the point, *e*, will be without the given major axis, B A. The point, *f*, will also be without B A; but *e* and *f* are the centres of the two lesser circles at the vertices of the major axis, and therefore, by a previous demonstration, the figure produced cannot be an ellipse. Rule T. does not answer, therefore, in a certain case; and, consequently, if correct in any, it can only be so in one.

Let us analyse D.'s rule in a similar manner. Suppose the proportion of major to minor axis to be as 3 to 1, then setting off B *b* equal to C *o*, half the remainder, *b o*, is equal to C *o;* marking off—to the left of *b*—*b e* equal to half *b o*, the point, *e*, will correspond with B, because B *b* was first made equal to C *o*, B *e* will, in this case, be nothing; and on joining B C, or *e c*, and bisecting it, C *h* will equal B *h*; and, consequently, the two arcs will meet at B and A, and the figure produced will be an arcus* instead of an ellipse. It may, in like manner, easily be demonstrated, that when the proportion is greater than 3 to 1, the two points, *e* and *f*, will be thrown beyond the extremities, B and A, of the major axis; they will therefore be without the figure, and it cannot, consequently, be an ellipse. Rule D., then, having been proved inapplicable in certain cases, cannot be applicable to more than one proportion of ellipse.

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* An *arcus* is a plane figure enclosed between two equal and similar arcs, each being less than a semicircle; and the corresponding solid I call an *arcsoid*, which is generated by the revolution of an arc of a circle, less than a semicircle, about its chord. I have found it convenient thus to name these two figures, as they so often occur.

To make all this quite clear, I have given two figures to illustrate the various arguments and deductions. The fallacy of T.'s rule is shown by fig. 1, where the proportion of major to minor axis is as 3 to 1. It will be there seen beyond dispute, that the points *e* and *f* fall without the circumference of the true ellipse, and so it will be the more as the ratio increases. As the ratio diminishes, the error becomes less; but the figure will be correct only in one case. That one case will be pointed out presently. Rule D. is applied in fig. 2, in which the points *e* and *f* correspond with A and B, and the figure produced by describing two circles from the centres, *g* and *h*, with radius, B *h*, will be an arcus; for the circles will intersect each other in B and A. Let the proportion be more than 3 to 1, and the points, *e* and *f*, will fall beyond the vertices, B and A. Let it be less, and these points will fall nearer the centre; but the resulting figure will be correct in only one case, which will be shown further on. Supposing B *o* to be bisected in *z*, the perpendicular erected thereon will be parallel to C D, and therefore will never meet it.

Fig. 1.

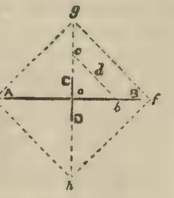
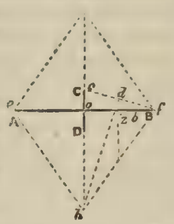


Fig. 2.



I will now give my method, which I will call Rule C. And I will here premise, that it is original on my part; for I used to be sorely puzzled to apply all existing rules which I found published, until, in a happy moment, I thought of this, which I have much pleasure in communicating to you, believing it will be found useful. Figs. 3, 4, 5, 6, and 7, must now be referred to The major axis being, B A, and the minor, C D, and *o* the centre; first, find a third proportional to A *o* and C *o*, either by calculation, as in figs. 5 and 7, or by construction, as in figs. 3, 4, and 6. This is done by producing B A and C D towards *y* and *g*, making A *y* equal to C *o*, joining C A, and through *y*, drawing *yx* parallel to C A. *x*C, Is a third proportional to A *o* and C *o*; that is, A *o* is to C *o*, as C *o* is to C *x*. Make B *f* equal to C *x*, and C *c* equal to B *f*; join *f c*, bisect it in *d*, and draw *dh* at right angles to *fc*, cutting C D, or C D produced, in *h;* then make A *e* equal to B *f*, and *o g* equal to *o h; g, e, h, f*, will be the centres of the four circles required, and by drawthrough *f* and *e*, *h i, h j, g l*, and *g k*, all equal to C *h*, the points where their arcs join are found. The radii of the greater circles will be *g l* and *h i;* and of the less, *f i* and *e j;* and the points of junction will be at *i, j, k, l;* the resulting compound figure, B *i* C *j* A *k* D *l*, shall be the ellipse required.

Fig. 3.

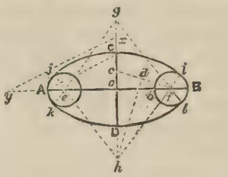
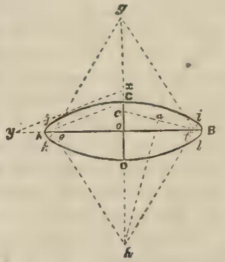


Fig. 4.



For, the proportions of an ellipse being infinite, any method of describing ellipses must answer in every possible case, or it cannot be the correct one. It is also evident, that, to be correct, the rule should possess some property that will vary as the proportions of the ellipse vary, or it cannot suit all cases. Let us examine the nature of an ellipse, to discover whether it possesses any property, the proportions of which are constant, and we find that the *latus rectum*[*] is always proportional to the axes; and that in all ellipses it is a third proportional to the major and minor axes. From this it appears, that the curve subtending the *latus rectum* varies as the *latus rectum;* and, therefore, that if it be the arc of a circle, its diameter will always be a third proportional to the major and minor axes. Now, in every ellipse, the centre divides both axes into equal parts, and consequently the circumference is equally divided by each axis. The *latus rectum* is also equally divided at the focus; therefore, half the *latus rectum* is always a third proportional to half the major and minor axes; and if the curve at the vertex of the major axis, subtending the *latus rectum*, be an arc, then will its radius—being half the diameter—be likewise a third proportional to the two half axes. The two *latera recta*, in every ellipse, being equal, the two segments of the circumference subtending each, are respectively equal to one another; consequently, if the curve at each extremity of the major axis be an arc, each arc will be equal and similar. Upon applying compasses to the small end of any ellipse, it will be seen, that with radius equal to half the *latus rectum*, the arc described will approximate indefinitely near to the curve; and, consequently, that a certain part of such arc may form, at each end of the major axis, a portion of the corresponding compound figure. The radius, then, of each of these two arcs being always equal to half the *latus rectum*, it follows that that radius is always a third proportional to half the major and minor axes. The remainder of the figure will, of course, be made up of two equal and similar arcs, whose radius is such that the circumference shall pass through the vertex of the minor axis, and, at the same time, touch the small circles internally. My rule is founded upon the previous reasoning, and therefore will produce a figure compounded of four arcs—each opposite arc being equal and similar—that will not differ materially from a true ellipse, and sufficiently near to be used in all cases for it.

Fig. 5.

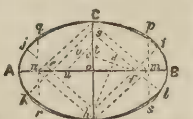
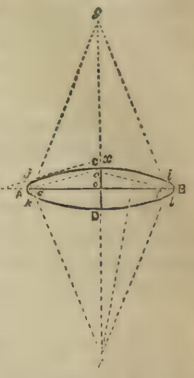


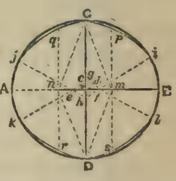
Fig. 6.



I will now analyse my mode of describing an ellipse, in order to discover if it is an application of the principles just laid down. If it be in accordance with those fundamental principles, it will evidently be a correct method.

If B A and C D—see fig. 3—be the given major and minor axes, C *o* will equal D *o*, and B *o* will equal A *o;* half the *latus rectum* will then be a third proportional to A *o* and C *o*, or to B *o* and C *o*. Produce A *o* towards *y*, and C *o* towards *g;* make A *y* equal to C *o*, join C A, and through *y* draw *x y*, parallel to C A: therefore, by Euclid VI. 11, C *x* is a third proportional to A *o* and C *o;* it is also half the *latus rectum;* consequently, according to one of the principles before expounded, C *x* will equal the radius of the two small circles required. Then, by making B *f*, C *c*, and A *e*, each equal to C *x*, they are all equal to one another; by joining *f c*, bisecting it in *d*, and erecting a perpendicular, *d h*, upon it, and joining *f h*, *c h* is equal to *f h* (Euclid I. 4); *o e* being equal to *o f*, *h e* is also equal to *f h*, and therefore to C *h*: then, by adding the equals C *c* and *f i* to the equals *h c* and *h f*, the wholes, C *h* and *h i*, are equal, and consequently, *h j* is also equal to *h* C and *h i*. By making *o g* equal to *o h*, it may then in like manner be proved, that *g e* and *g f* are equal to each other, and also to *h f* and *h e;* producing *g e* and *g f* to *h* and *l*, and making *e k* and *f l* equal to *e* A and *f* B, *g l* and *g k* will be equal to each other, and also to *h i* and *h j;* therefore, *h i, h j, g k, g l*, C *h*, and D *g*, are all equal. Then, if circles be described at *e* and *h*, with the radii *e j* and *h j*, the two circles will touch internally, and the point of contact will be at *j*—Euclid III. 11. In like manner it can be shown, that *i* shall be the other point, where the same and an equal circle touch internally, and the circumference of the greater circle will pass through the vertex of the minor axis, because *h j* is equal to *h* C; therefore, by a previous demonstration, the curve, B *i* C *j* A, is half the circumference of an ellipse. In a similar way, B *l* D *k* A can be proved to be equal and similar to B *i* C *j* A; consequently, the figure enclosed by both is an ellipse, whose major axis is B A, and minor C D, which is the figure required. It appears, then, that the rule before given suffices; and as its fundamental principles are universally true, so will this rule be always correct.

Fig. 7.



The figure produced by rule C. will never be an exact ellipse (as is shown in figs. 5 and 7, where *p, q, r*, and *s*, are the vertices of the *latera recta*, through which the true ellipse passes), but is in every case sufficiently near; besides which, it is the nearest figure to an ellipse that can possibly be constructed with the common compasses.

It is evident that the lines uniting the four centres, *f, g, e, h*, will always form a rhombus or a square, and that the opposite sides and radii will always be equal and parallel; and hence, a parallel rule can be used with good effect in this construction.

It now only remains to show the solitary proportion of ellipse that can be drawn severally by rules T. and D. Fig. 5 illustrates the only case in which rules T. and C. agree, and consequently the only proportion of ellipse that can be formed by rule T. The letters *t, v, u*, denote the line used in this construction, in which instance it is found that *e* A is equal to B *f*, and is therefore a third proportional to B *o* and C *o;* and, in consequence, the result of both methods is the same. The proportion of the

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[*] The *latus rectum* is a right line drawn through either of the foci of any ellipse at right angles to the major axis or greater diameter, and terminating both ways in the circumference.

SIMPSON'S ELEVATING MACHINE.

Fig. 1.

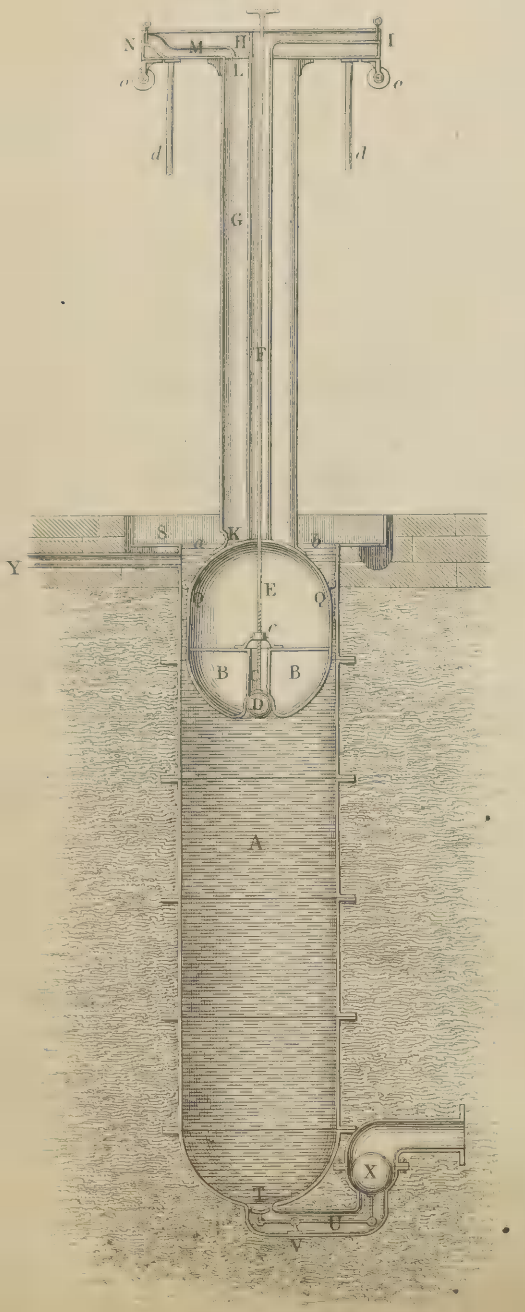


Fig. 2.

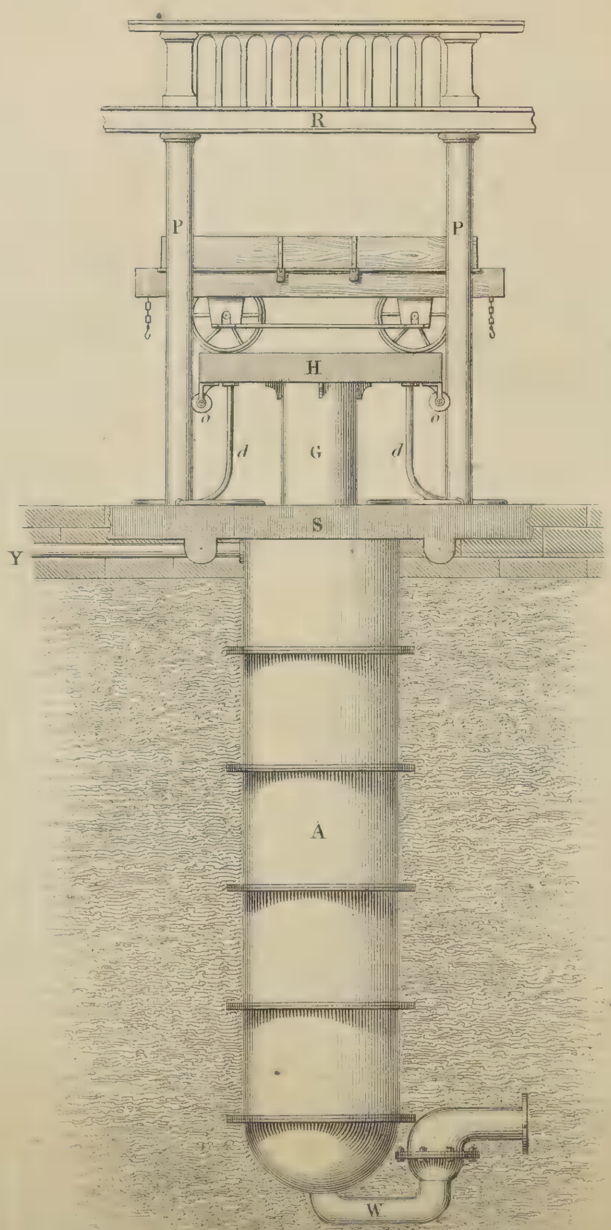
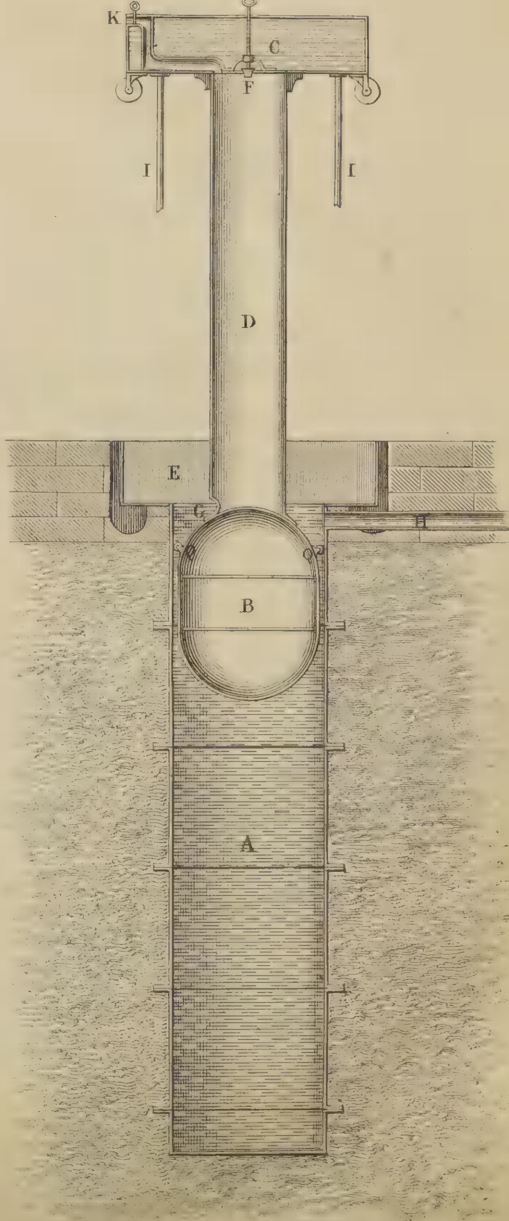


Fig. 3.



Scale

12 6 0 1 2 3 4 5 10 15 20 25 30 Feet

W. Johnson,
Patent Office, Glasgow.

Printed by Maclure & Macdonald, Glasgow, L'pool & London

Engd. by Geo. Aikman, Edinr.

major to the minor axis is here as 3 to 2. No ellipse, then, can be described by rule T. correctly, unless the proportions of it be as 3 to 2.

Fig. 3 exhibits the only example where rules D. and C. agree. The proportion there is as 2 to 1, when it is evident that half the difference between the semi-minor axis and the semi-major axis, will be half the semi-minor axis; or, half *b o* is equal to *b f*, B *f*, and C *c*. But, by construction, C *c* is equal to C *x* and B *f*, wherefore, B *f* is equal to C *x*; and C *x* is a third proportional to B *o* and C *o*, therefore, B *f*, the radius of the small circle, is a third proportional to B *o* and C *o*, as it was made by rule C.; and, in consequence, the result of both methods is here the same. This, however, is the only case where rule D. is correct, viz., when the proportions of the required ellipse are as 2 to 1.

In would seem, by the coincidence of rules T. and D. with C. in two separate instances, that their inventors have started both from the same point, but have mistaken the proper construction, and taking a wrong road, have each wandered further from the truth; while C., by investigating the principles of the construction, and analysing the nature of the figure, has alone found the right key with which alone the lock can be picked.

I enclose the rule, expressed in the simplest and readiest manner, so as easily to be applied in practice.

Rule for Drawing any Ellipse.—Figs. 8 and 9.

Let A B be any major axis, and C D any minor axis; produce them both in either direction, say towards F and H, and make A F equal to C G; then join C A, and through F draw F H, parallel to C A. Set off B I, A J, and C K, equal to H C; join J K, and bisect it in R, and at R erect a perpendicular, cutting C D, or C D produced, at M; then make G E equal to G M: J, E, I, M, will be the centres of the four circles required. Through the points J and I, draw M N, M O, E P, E Q, each equal to M C; then M N and E P will be the radii of the greater circles, and J N, I O, of the less: the points of contact will therefore be at N, O, P, Q, and the figure drawn through A, N, C, O, B, Q, D, P, will be the required ellipse.

Fig. 8.

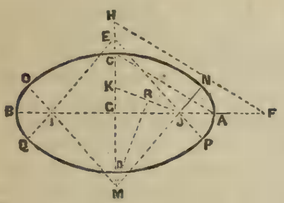
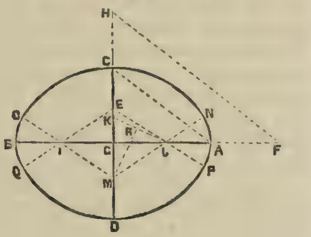


Fig. 9.



John Crane.

Lee Crescent, Birmingham, Dec. 17, 1849.

SIMPSON'S HYDRO-PNEUMATIC LIFT FOR FURNACES AND RAILWAY ELEVATORS.

(*Illustrated by Plate* 43.)

The pages of the *Practical Mechanic's Journal* have seldom brought forward a more beautiful invention than the one we are now about to describe, which is particularly interesting, as well for its elegance and simplicity of action, as for its eminent commercial value. In contrivances so common as raising and lowering machines, ample room has been afforded for the application of varieties of mechanism, and, consequently, we have had a fair trial of each. Steam-hoists, vertical screw-lifts, pneumatic lifts, water-balances, *et hoc genus omne*, have been largely adopted; therefore, we think we may claim some merit for Mr. Simpson when we state, that he performs all the necessary operations of lifting and lowering mechanism, simply with the help of a reservoir of water and a buoyant air-vessel.

The point of Mr. Simpson's invention consists, then, in the application of that branch of hydrodynamics, which comprehends the principle of hydrostatics, or flotation, to various mechanical arrangements, whereby the movements necessary for elevating materials to furnace mouths, or for raising and lowering goods at railway stations or in manufactories, or for taking up and letting down boats, in place of the ordinary canal-locks, are accomplished without the expenditure of any mechanical power whatever.

Plate 43 exhibits three views of the arrangements adapted as a furnace lift. Fig. 1 is a vertical section of the well, or reservoir of water, air-vessel and lifting case, and the elevating platform for carrying the materials, the apparatus being represented at the top of its lift. Fig. 2 is a corresponding external elevation of the same parts, with the addition of the guiding columns, and the furnace stage to which the materials are to be hoisted, the elevating platform being here represented about midway in its lift. Fig. 3 is a vertical section of another modification of a furnace elevator, differing slightly in its details from that delineated in figs. 1 and 2. In the latter, A, is the water reservoir, or well of cast-iron, filled with water up to the level, *a b*, and of such a diameter as to receive easily the air-case or cylinder, B B, which is kept constantly full of air, and is of such capacity as nearly to balance the weight of the moveable portion of the lifting apparatus without any load. It has a vertical passage through its centre, at C, having a ball-valve, D, at the bottom, allowing of a communication between the well, A, and chamber, E, immediately over the air-vessel, which chamber has a vertical pipe, F, springing from its hemispherical top, and passing up through the centre of the long lifting-case, or cylinder, G, to the hollow platform, H, where it is bent at right angles, and terminates in a valve, I, at the edge of the platform.

The capacity of the chamber, E, is large enough to give it a displacement equal to the weight of the greatest load to be lifted, and the cylinder, G, having on its top the elevating platform, H, whilst, at the bottom, it is bolted to the top of the chamber, E, is quite closed, with the exception of a side-opening, K, at the bottom, for the influx or efflux of water from the well, and another aperture, L, at the top, in communication with the passage, M, in the platform, terminating in a valve at N, by which the entrance or exit of air to the case, G, is governed. As the case, G, the chamber, E, and the air-vessel, B B, are all connected together, they form, as a whole, the lifting-case for the platform, H, which is guided in its vertical movement by four pulleys, O O, working against the columns, P P, and, in addition, by the pulleys, Q Q, carried by the chamber, E, and working against the interior of the well. These columns carry the fixed stage, or platform, H, being the level to which the materials, as coal and ironstone, are to be raised for discharging into the furnace. This is the general arrangement of the machinery when intended for working where there is no descending load further than the mere conveying apparatus, as, in such a case, it is necessary to provide a means for carrying down the air-case in opposition to the buoyant power used for elevating the load. The valve, D, at the bottom of the passage, C, through the chamber, E, is worked by a handle passing up to the top of the platform through the pipe, F. The machine, represented in fig. 1, being at the top of its lift, as it would be after raising a load of materials to the furnace mouth, to cause it to descend, the valve, D, must be opened, by turning its handle, so as to screw it down by the fixed nut, *c*, as also the air-valve, I, at the top of the pipe, F, in the platform, when water from the well will enter the chamber, E, and displace the air contained in it, the air passing out at the top. At the same time, the valve, N, communicating with the top of the case, G, is opened to allow the air to escape from it, whilst water from the well enters at the bottom by the opening, K.

The case then sinks in the well at a rate capable of regulation by the valves, N and I. At the bottom of the descent, the platform sinks into the recess, S, at the loading level, and the next supply of materials is deposited upon it for lifting. As the case approaches the bottom, the bottom of the spherical valve, D, presses on the top of the cup-piece, T, on the short end of the lever, U, working on a centre at V, in the branch-pipe, W, opening into the hemispherical bottom of the well. The downward pressure upon this lever, elevating the opposite end of the lever, raises the large metal ball, X, opening the discharge-end of the pipe, W. The ball, X, acts as a weighted valve to prevent the discharge of water from the well, until actuated by some additional pressure; and it must consequently be heavy enough to resist the head pressure of the column of water of the height of that contained in the well. Just as the ball, X, is raised, the bottom of the air-vessel, B B, settles down into the bottom of the well, and being formed hemispherically, the two surfaces fit close together, so as to prevent any water from the well getting between, the tightness of the surfaces being assisted, if necessary, by a packing ring placed in the well bottom.

In this position of the elevator, if the valve, I, in the platform is kept shut, no upward movement of the elevator can take place; but when it is opened, the water contained in the chamber, E, will flow out through the passage, C, until this chamber becomes sufficiently buoyant to raise the load which has been placed on the platform, the water discharged being either allowed to run off to a lower level, or pumped up to the top of the well by the inlet, Y.

When the requisite quantity of water has run out, the valve, D, is again screwed up against its seat, the case will again rise, carrying up its load to the level of the fixed platform, R, at a rate of movement adjustable at pleasure by the air-valve, which allows the air to flow in at the top of the lifting-case, G, whilst the water contained in it flows out at the bottom by the opening, K. The valve, I, communicating with the chamber, E, may also be used as a regulator, being opened or closed as is found necessary. On the arrival of the load at the top of the lift it is discharged, and the process we have already described is repeated, to cause the empty platform to descend.

The peculiar object of the opening, K, in the bottom of the cylinder, G, is to admit water into the latter from the well as the descent is made, in order that the buoyant power may not be affected by the greater or less depth to which the case and air-vessel is sunk into the well, the water-level in the well being unaffected by the greater or less immersion of the case, further than to the slight amount due to the presence or absence of the mere bulk of the metal of which the case is formed; for, as the latter sinks, the entering water always preserves the level in the interior of the case at the same level as that of the well.

It is obvious, that when the case is sunk, it loses so much effective weight as is due to the amount of water displaced by the bulk of metal forming its sides, and therefore, unless some compensating agent is employed, the buoyant power will vary to a certain extent, according to the depth of immersion. To remove this objection, Mr. Simpson has designed a most ingenious equilibrating arrangement, whereby the buoyant power is equalised throughout the whole rise or fall. The elevating platform, H, is made hollow, to receive a supply of water, and to the bottom of the platform are attached the open ends of two flexible pipes, *dd*, of gutta percha or india-rubber, forming a direct communication between the platform and the bases of the columnar pipes, P P. The capacity of these pipes must be large enough to receive as much water as is displaced by the immersed metal of the case; and, as the latter rises, the water contained in the platform-chamber is gradually discharged by the flexible pipes into one or more of the columns, P P, to be again received back into the platform-chest, when the latter descends. In the descent, the case gradually becomes practically lighter, from its increasing immersion; therefore, the water in the pipes, P P, now flows from their bases, through the flexible pipes, into the platform, where its weight acts as a regular compensating power for the increasing buoyancy gained in this way. Various arrangements may be adopted for the production of an equilibrating power, as, for example, a weight acting on a system of differential pulleys; but the contrivance we have shown appears to be the most advantageous for the end. It will be perceived that, in this machine, for every ton of materials carried up, the same weight of water must be discharged from the chamber, E, with a slight additional quantity to allow for the working friction; and in this particular, the scheme possesses very considerable economy over the ordinary class of elevators, where the gravity of water is used as the elevating power, as in such elevators there is usually a considerable loss of water, over and above the weight theoretically necessary to raise the load, in addition to that required to overcome the working friction.

In fig. 3 is given a vertical section of a well and lifting-case rather differently arranged. The well, A, is here constructed and arranged as in figs. 1 and 2, but the lifting air-vessel, B, is in one single compartment. It is of a sufficient capacity to give a buoyancy equal to the elevation of the greatest load of the machine, including the moving portion of the mechanism. The hollow platform, C, at the top of the case, D, is constructed to hold a quantity of water sufficient to sink the case and air-vessel, and by means of this weight of water the capability of descent without a load is obtained. When the platform arrives at the bottom, and settles into its recess, E, the water employed to sink it is run off by the valve, F, which permits it to flow through into the case, D, and out at the opening, G, at the bottom, to the well, whence it may be carried off, as it overflows, by the discharge pile, H. After the water is thus run off from the platform-chest, the machine is ready for elevating a load equal in weight to that of the water so run off—the velocity of the ascent being regulated, as before, by the air-valve, K, opening into the top of the cylinder, D. The flexible tubes, I I, represented as broken away, are fitted, as in fig. 2, to act as conductors for the water employed as the compensating weight.

In cases where an apparatus constructed on this principle is employed for lowering only, it is evident that the load, if more than equal to the buoyancy of the air-vessel, will sink the platform and case without the assistance of the water in the platform-chest, and in situations where considerable hydrostatic power is conveniently attainable, as from water-pipes supplied from elevated sources, such power may be usefully employed for the depression of the unloaded machinery.

It will be observed, from the foregoing description, that it is only where goods or materials are constantly passing upwards that a loss of water arises. In the employment of the apparatus in warehouses or at railway stations, where goods pass both ways, the additional counterbalancing weight of water is dispensed with, as the weight of the goods, in passing downwards, depresses the buoyant chambers.

Other ramifications of Mr. Simpson's plans apply to the raising, lowering, and tipping waggons or goods into ships; for harbour purposes; for raising mine materials; and for raising and lowering boats on canals, in place of forming locks. Probably the most interesting of the applications of the principle is that of the substitute for canal locks, where any load less than the buoyant power of the air-vessel may be transmitted from the lower to the higher level; or any weight greater than the buoyant power, from the higher to the lower level, without losing, or discharging from the higher to the lower level, the great quantity of water lost in locks, in most arrangements of which, the loss of water, at each passage, is equal to the whole contents of the lock-chamber. In most cases where this species of canal lift is applied, the loss of water during the transmission of a load will be very slight; and in certain circumstances, as, for example, where the heavy traffic is all downwards, not only will there be no loss, but water will be absolutely lifted from the lower to the higher level. Where the traffic is pretty equal in each direction, no loss of water will ensue, and it is only where the loads all ascend, that any escape of water will arise.

In a future part, we shall give a full detailed plate of the canal lift, showing its application to the greatest height of lift now in use.

THE GEOLOGY OF THE OCHILLS.

By Mr. R. Smith, Blackford.

I.

Foremost amongst Scotland's mountainous ranges, are to be reckoned the Grampians, extending from Ben-Lomond on the south-west, to Stonehaven on the north-east, and to the south of the chain, and nearly parallel, to it rise the Ochills—"the green hills of Caledonia"—bounded on the west by the Campsie hills, and eastwards by the Sidlaw. Of picturesque beauty the Ochills have a fair share, their uneven surface, from base to summit, being covered with a rich green sward, over which innumerable mountain-streamlets gurgle along in their passage to the "links of Forth," the winding Devon, and the meandering Earn; whilst the jutting crags, crested with the waving fern, mountain-ash, and heather-bell, contrast delightfully with the luxuriantly cultivated plains beneath, and with the dark sides of the Grampians on the north.

Like the other Scottish ridges, the substance of the Ochills consists of rocks of igneous origin, termed platonic; their texture and general appearance show that they have originally been in a fluid state, having, at some ancient period, been melted in the earth's bowels, and thrown up by the convulsions which were not unfrequent in earlier times. The force arising from the action of fire beneath the earth's surface has been termed the elevating cause or principle; and one of the main arguments of the advocates of the theory of the ancient state of fusion of the earth's materials arises out of its present form, which is that assumable by a fluid body revolving upon its own centre. It is further presumed, on this side of the question, that the mass of the earth was at one time in a gaseous state, that it then became fluid, and, finally, being covered with an oxidised crust or film, that it gradually attained its present solid state and form.

As the crust grew thicker, the mass must have continually cooled down, and yet no one, so far as we can gather, has yet ventured an explanation as to what has become of the lost heat. The formation of the earth, as well as the changes and convulsions to which it has been incessantly subjected through past ages, are probably the result of that mysterious power—electricity—directed by the influence and sway of creative wisdom. Electricity is developed by friction, by change of temperature, by chemical action, by contact, and by changes of form, such as liquefaction and solidification, and the formation and condensation of vapour. Its effects are at one time seen in the decomposition of matter; at others, in its re-formation. In its current form, it separates the elements of water into gases, and, in its condensed state, it makes these gaseous elements reunite and become water. By it the hardest and most compact metals are melted, the most beautiful crystals are developed, and obdurate metals are precipitated from their solutions. With such effects before us, and knowing the earth to be the great reservoir of electricity, it is not unreasonable to assign to its influence the origin of the heat of the globe, terrestrial magnetism, the production of gases and water, the crystallization of minerals, the production and distribution of metallic ores, the convulsive throes of earthquakes, and the vomiting of the volcano.

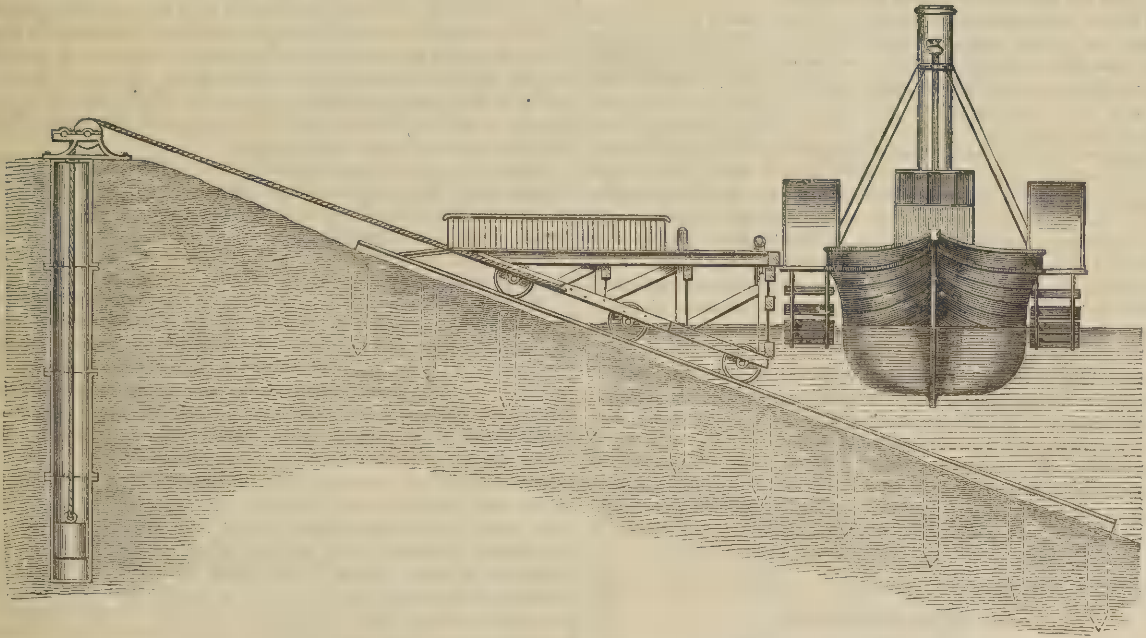
The rocks of the Ochill ridge belong to what we recognise as the primary and transition formations. Granite, of a brownish tinge, is found in certain localities, as Craig-Rossie; it is of very serviceable quality, and is much used by the builder. Greenstone, olivine, jarcolite, and quartz, are all found in Glen-Devon. Of the varieties of quartz, many specimens, considered to be of the most magnificent kind, are in the possession of Mr. Archer of Tullibardine Cottage. Lepidolite, containing a small amount of the ore of lithium, has been found near Kinross, and Rutile, containing 55 per cent. of titanium, was discovered by the writer, a few months ago, at Ben-Heath, near Blackford. In almost every corner of the Ochills, agates are to be met with; those found at Struie, in the neighbourhood of the Path of Condie, are considered to be equal, if not superior, to any others in Scotland.

In endeavouring to account for the origin of agates, some theorists hold that silica in solution has poured into the cavities with which platonic rocks abound; the supposition being strengthened by the fact, that when a rock is cut in a vertical direction, the aperture giving admission to the siliceous solution may be at once perceived. In the opinion of the writer, the formation of these stones may be more satisfactorily accounted for, on the supposition, that when the mass composing the platonic rocks was in a state of fusion, occasioned, it may be, by the action of electricity, then, according to the laws of cohesion and elective attraction, in some cases two or more substances would unite and form compound masses: in others, the matter unpossessed of elective affinity for its neighbours would remain uncombined; and it is probable that the siliceous particles would be attracted towards each other, collecting into globules, forming agates, which would be deposited throughout the entire mass—hence the whole would be formed at one and the same time.

Copper has been met with in different parts of the Ochills. Mines were opened at Airthrie, Alva, and Dollar, and were carried on for a considerable period; but for a long time they have been abandoned, for reasons not duly understood. These mines contain, in addition to copper, pyrites, malachite, cobalt, and arsenic. A few years ago the writer hit upon a vein of copper in the east hill of Glen-Eagles, the specimens of the ore taken up from it giving a per centage of from 14 to 35. The vein also contains strontia, and a large quantity of sulphate of barytes, with cobalt and arsenic. Lead has also been found here, and a mine was wrought some time ago near Castle-Campbell, Dollar. The principal ore obtained was a sulphuret of lead (galena), containing a considerable proportion of silver. After working it some time, the vein was found to diminish rapidly in thickness, and it has since been abandoned.

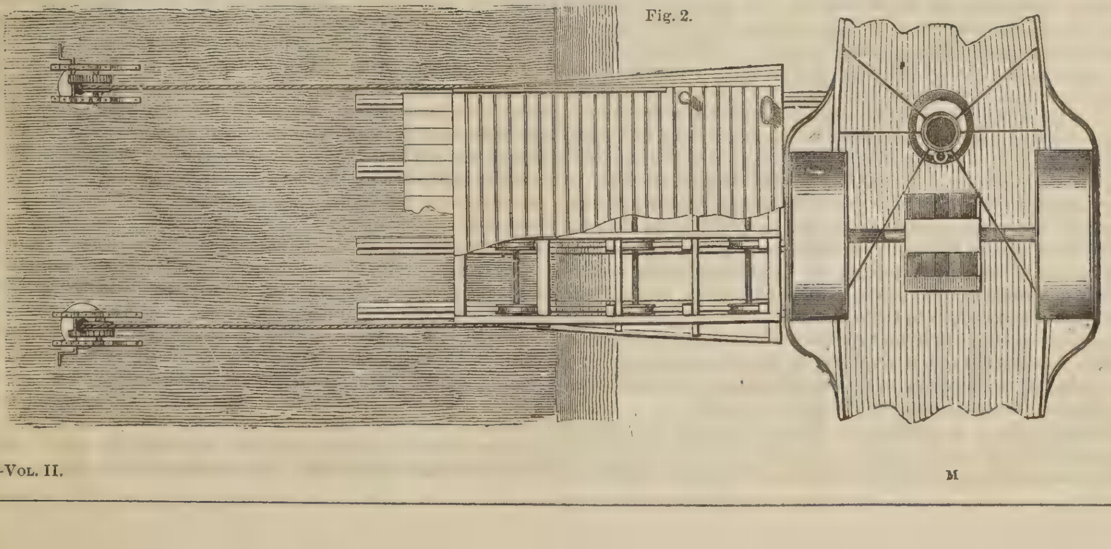
ROBERTSON'S SELF-ADJUSTING LANDING-STAGE FOR STEAMERS.

Fig. 1



Our steam-boat travelling readers will hardly pass over the two views which illustrate this article, without at least pausing to ascertain the capabilities of the plan which they illustrate, for removing a long-standing nuisance in connection with the existing system of embarking and disembarking at intermediate stations. Hand in hand with the grumblings at bad inns, comes a fitting feeling of disgust at the disagreeables

Fig. 2.



too often aroused by the very inefficient accommodation so general in our rivers and lochs. Long after many charming localities have evidenced their right and title to better usage, the old slow ferry-boat is kept up, to the infinite dissatisfaction of the hapless passengers of a crowded steamer, heightened, in many instances, by the evils of stormy weather; and when, at last, a quay is established, we have a rude and ricketty affair, for the use of which is charged a heavy per centage upon our very moderate steamer fares. It is not our present purpose, however, to grumble throughout the page, but to introduce what we may term a "self-adjusting" landing-stage, of a new construction, which has been laid before us by Mr. P. Robertson, the superintendent of locomotives on the Ayrshire Railway.

Our first figure illustrates the proposed arrangement by a section of a landing-station, showing the stage in elevation, with its guide-rails and counter-weights, and a steamer alongside. The second figure is a corresponding plan of the stage and steamer, part of the platform of the stage being broken away to show the frame and carrying wheels. The details almost explain themselves, the stage being little more than a diagonal timber framework, carried upon a set of twelve double-flanged wheels, running on guide-rails laid on continuous timber bearers, which are carried on the sloping surface of the shore by rows of piles. Of course, the structure will vary with the nature of the shore—its natural inclination, and the materials of which it is formed.

On each side of the framework is attached a rope or chain, passing back over two pulleys, carried on standards bolted down to the top or closed end of two pipes, which form recesses or wells for the counterweights employed to balance the pull of the stage upon its incline. These wells may be formed in various ways, but we have represented them as a line of pipes, three feet bore, closed at the bottom—an end, also, being cast on the top length, with a hole for the counterweight ropes to pass through.

The position of the stage is pretty nearly what it would be at high water, being nearly at the top of its incline. As the tide recedes, the stage, losing the buoyant support of the water, follows it down the incline, the counterweights rising to allow of this descent, whilst they again fall as the succeeding rise of tide again brings up the stage. With this arrangement the passenger always finds direct and convenient access to the steamer lying alongside—stepping upon a short entrance platform, which is placed at the landward end of the stage to connect it with the shore.

The ground plan shows more clearly the wheel and pinion arrangement intended for hauling up the stage when necessary, in case of severe storms, or for repairs. In ordinary duty, this gearing never comes into use, as the combined action of the tide and counterweights constantly adjusts the platform to the required level of the steamer's deck.

We should be glad to see the plan tried in some of our lochs, as it is simple, and, to our mind, most effective; and lastly, it is cheap. In the Gareloch, for example, at Roseneath or at Shandon ferry, it might be fairly and usefully tried.

WORKSHOP ECONOMICS.

M'DOWALL'S WOOD-PLANING MACHINE.

(*Illustrated by Plates* 42 *and* 44.)

We this month redeem our promise of giving a second plate of this machine, as now constructed by Mr. M'Dowall, with a detailed account of its action. Before entering upon a direct explanation of the peculiarities of the mechanism of this example of planing machinery, we may sketch some notes on the history of this class of constructive mechanism, which deservedly finds a place in our chapters on "workshop economics."

The extent of the economy gained by the introduction of accurate mechanical means for producing plane surfaces on flooring-boards, and other timber surfaces, is seen at a glance, on comparing the feeble and irregular action of a joiner's hand-plane, with the speed and efficient working of mechanically-impelled cutters. After the hand-sawing of the workshop, no other operation consumes so much of the workman's time as the production of the hand-planed surface. In addition to this objection, we have the graver one of inaccurate action; for in all hand tools, the instrument rests immediately upon the face which is being formed, and there is, therefore, no guide for the truth of surface, and in repeating any given result, every successive individual piece of timber demands the same care as the first. Besides the enormous saving in time, then, we have, in a well-arranged planing machine, an invaluable advantage in the fact, that when once adjusted, future accuracy is effectually secured.

The earliestapplication of mechanism for planing wood was by General Bentham, who, in 1791, patented a machine, the action of which was based on that of the common plane. In this imperfect contrivance, the plane, or cutting edge, was moveable, and of the full width of the board intended to be planed, and fillets were placed on each side, so as to project below the cutting face to the amount of the thickness of cut. After various modifications and attempts at giving a good surface to a very thin board, the scheme fell through. It was never practically worked by mechanical power; but in whatever way this was done, the plan certainly had the advantage of exonerating the attendant workman from the charge which he had of his hand-tool, rendering a mere labourer as useful as a skilled wood-worker for this purpose. Somewhat analogous in principle is the *scaleboard* plane, employed for shaving off the wide chips used for thin boxes.

In 1802, Mr. Bramah patented a mode of producing "straight, smooth, parallel, and curvilinear surfaces on wood, and other materials;" and one of his machines is now in the gun-carriage department at the Woolwich arsenal. The timber is passed beneath a large horizontal wheel, carrying twenty-eight gouges, set horizontally in succession round its periphery, and running at the rate of ninety revolutions per minute. The gouges are so set as to act as roughers and finishers, the last finishing tools being two double irons like those of the ordinary plane.

It was not, however, until the year 1827, that machines for working flooring and other boards were brought into anything like practical use, when Mr. Malcolm Muir of Glasgow invented and patented a machine which has since served as a model for all succeeding makers. The bottom of the board is roughly planed by a rotatory adze, whilst another operates in like manner on its upper surface. The work is then passed between two fixed cutters, set obliquely, to remove a shaving of the length and width of the deal; two revolving cutters, or saws, make the sides parallel, and two others groove the edges for the tongue. The names of Paxton, Burnett, and Poyer, are also deserving of mention, as inventors of this class of mechanism.

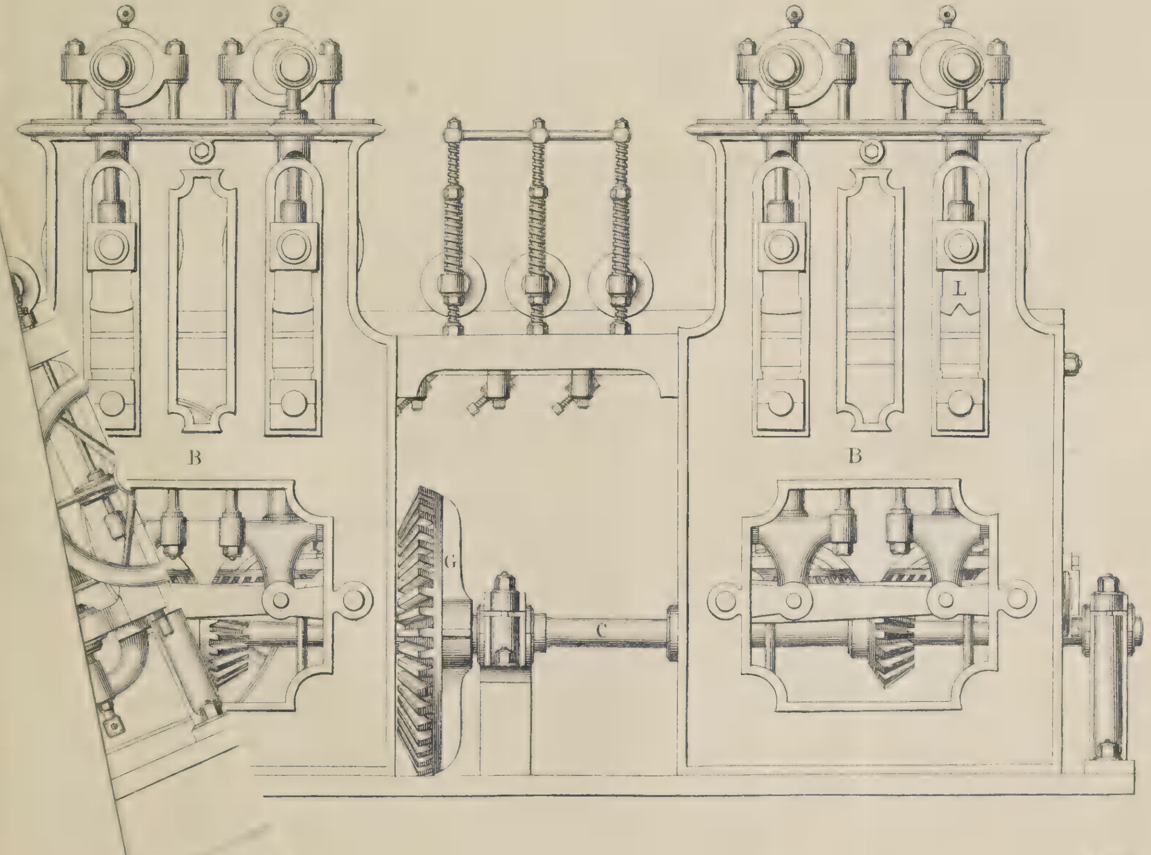
Many of the machines originally made by Mr. Muir are still in use in Glasgow and the neighbourhood; and although different modifications have been introduced, yet the essential parts of Mr. Muir's arrangement, as the plane-bed, the system of plane-irons, and the dibber, or scutcher, for adzing off the over-wood from the underside of the board, so as to reduce it to a uniform thickness, remain as he left them.

The latest improvements on his model are embodied in the machine illustrated in our plates 42 and 44, by Mr. John M'Dowall, of the Walkinshaw Foundry, Johnstone. In 1834, Mr. M'Dowall erected one of Muir's machines in Manchester, but on account of the flooring and lining used in that part of the country being so much thinner and broader than that generally worked in Scotland, very considerable difficulty was met with, in getting it to work as intended. The boards were led through the machine by an endless chain, with hooks fitted to catch on the ends of the boards, but owing to the extreme thinness and breadth of the Lancashire boards, much inconvenience resulted from the tendency of the hooks to tear out of the wood. To remove this objection, Mr. M'Dowall introduced two pairs of rollers at the front and back of the machine, to carry through the boards by frictional pressure. These rollers were of cast-iron, 12 inches in length, and 10 in diameter, accurately turned, and made to act like the rollers of calendering machines, the upper ones being held down by weighted levers, to give them a good hold upon the wood passing through between them. This improvement effectually answered its purpose, as, by adopting it, the thinnest boards could be taken through without difficulty, and the product of the machine was greatly increased. The next step in the improvements was in the grooving and feathering apparatus. Mr. Muir employed saws for jointing the boards and forming the feathers, four saws being necessary in producing the feather, one cutting up, another cutting down, and two cutting in, so that two thin strips are cut off the sides, leaving the tongue, or feather, in the centre. In making feathers on thin boards, these saws were found to be very inefficient, and Mr. M'Dowall substituted for them a set of rotatory cutters, the irons of which were of the exact size of the section of the groove or feather required, at the same time making provision for placing irons in the heads of the machine, to form mouldings on the edges where necessary. These improvements were included in a patent for certain improvements in machinery for cutting timber, taken out by Mr. M'Dowall in Ireland, in the year 1836.

Plate 42 represents, in its two figures, a side and end elevation of the machine, and the corresponding ground plan is given in plate 44. The same letters refer to the same parts in all the views. The whole cutting apparatus and gearing is carried upon a cast-iron sole-plate, A. Upon this plate are erected six standards, B B, three on each side, bound together by longitudinal and transverse stays, forming a strong rectangular frame. The horizontal shaft, C, running along the whole length of the machine at the back, carries a set of bevel wheels, driving a series of upright shafts, H, which again are connected by bevel gearing, J, with the horizontal roller shafts. The machine is driven by a cross horizontal

M^c DOWALL'S

WOOD PLANING MACHINE.



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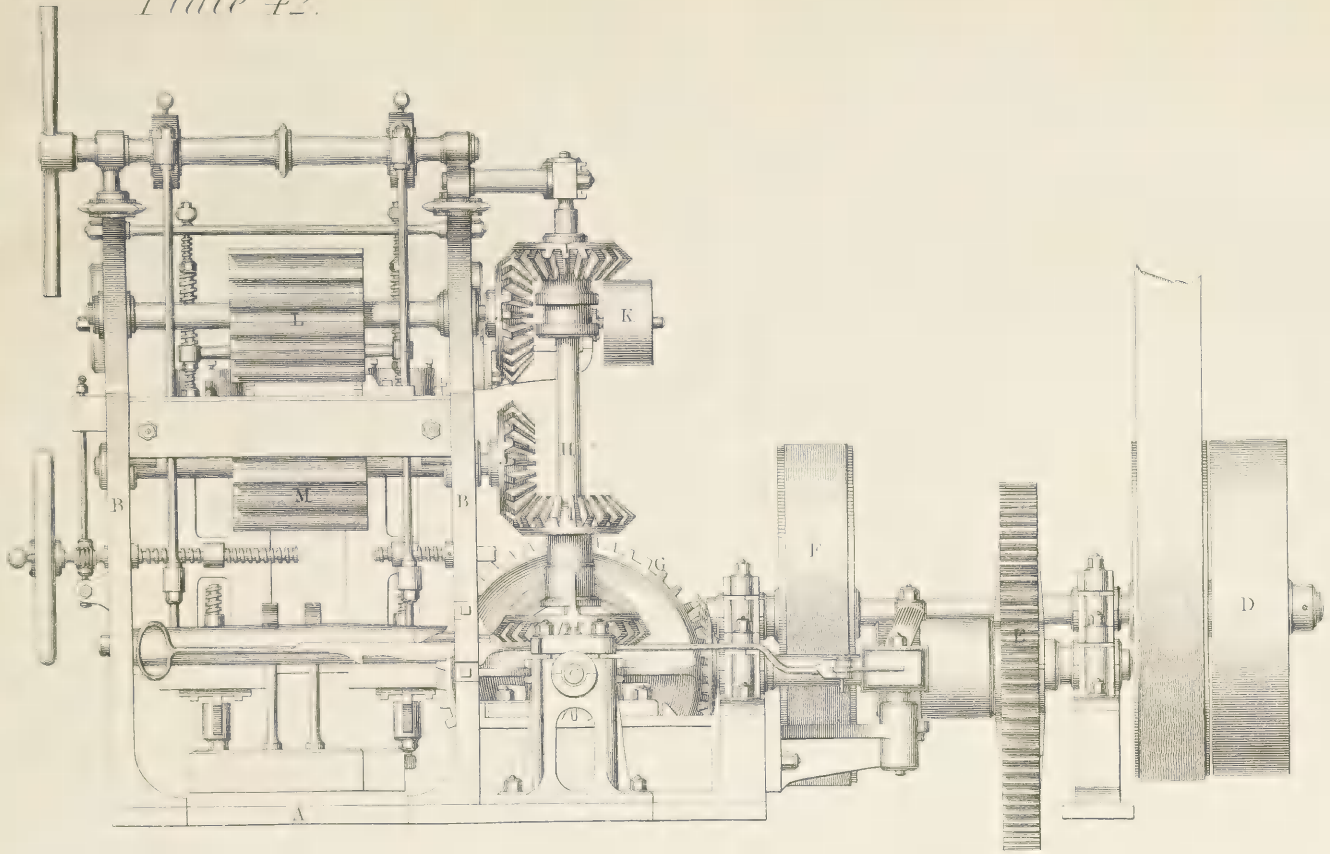

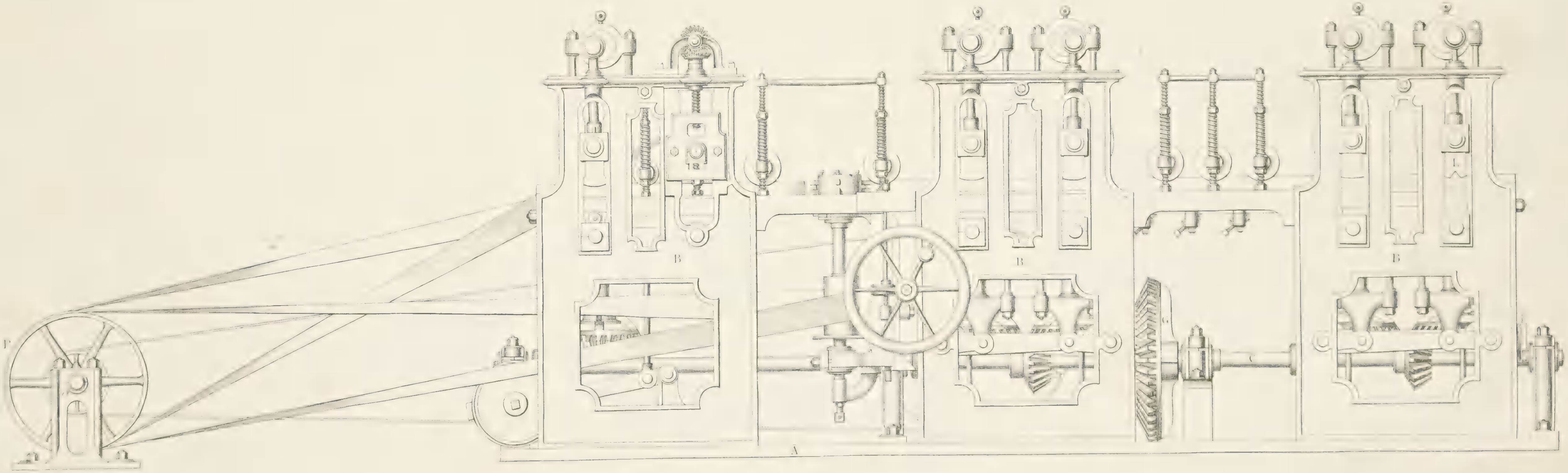

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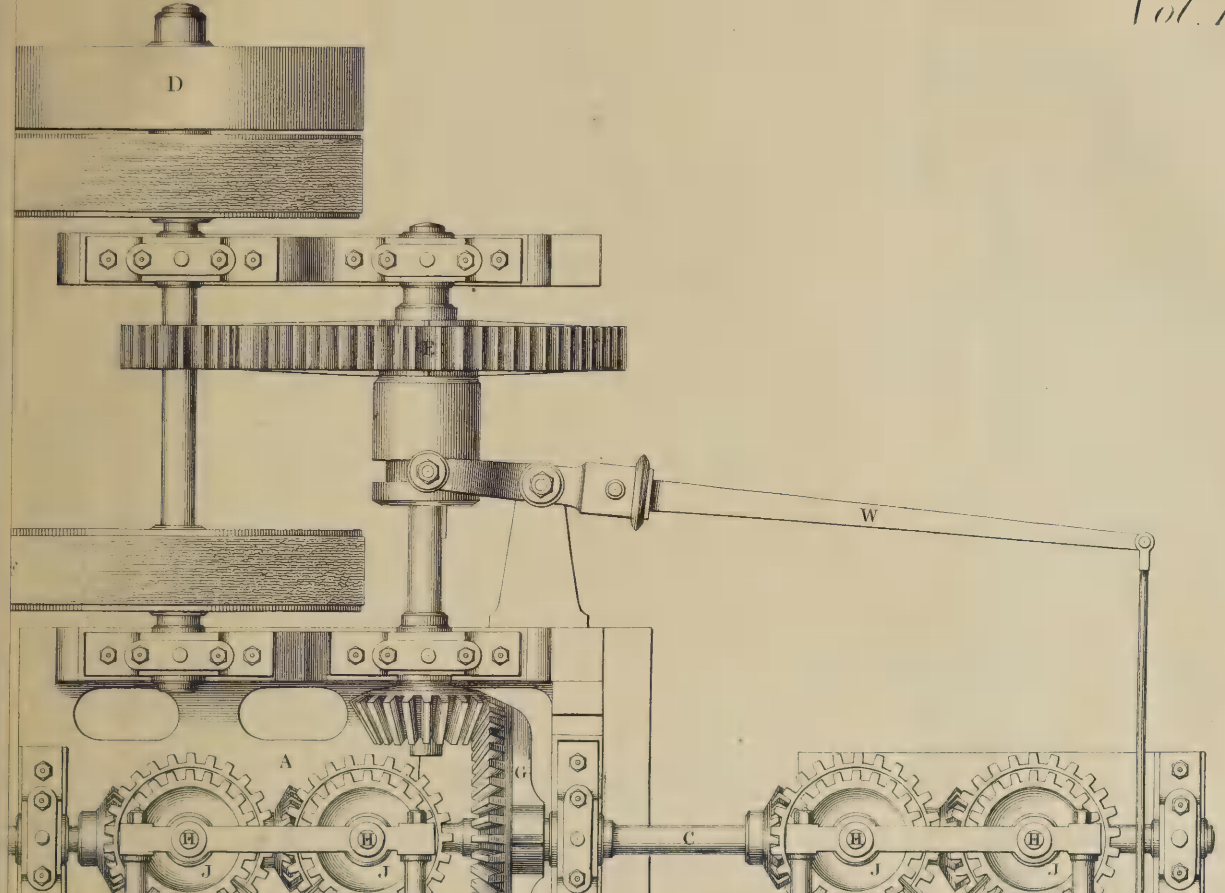

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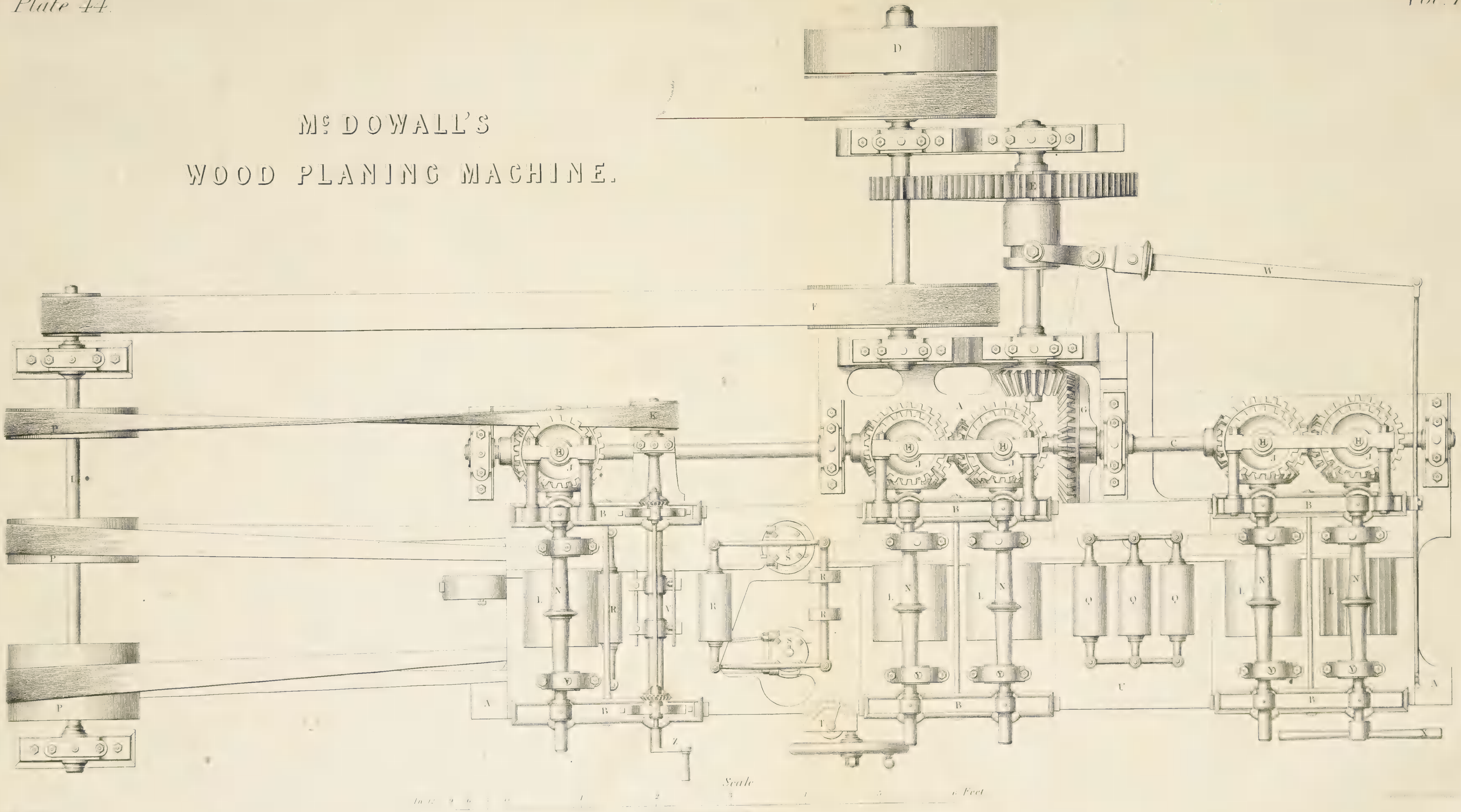
McDOWALL'S
WOOD PLANING MACHINE.

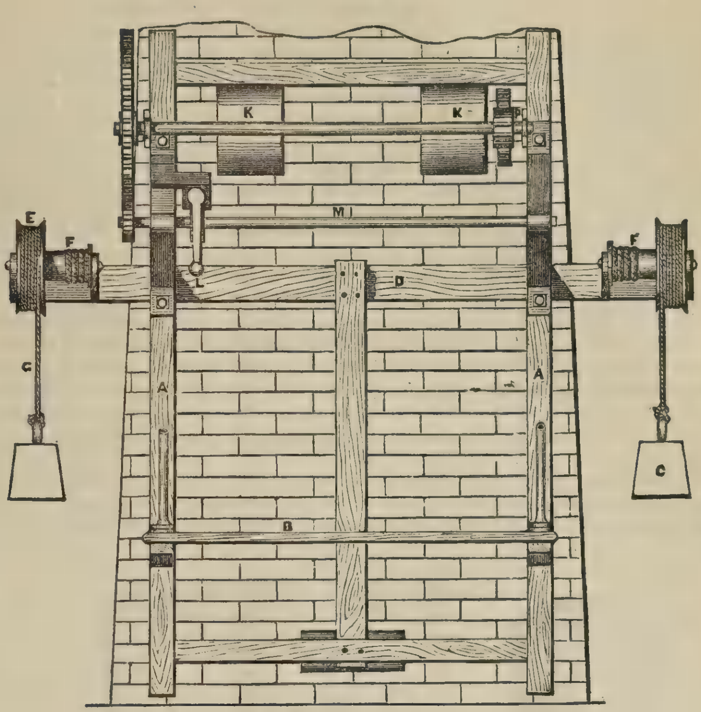


shaft, carrying the fast and loose pulleys, D. This shaft has upon it a spur-pinion, gearing with the large spur-wheel, E, which has, upon its opposite end, a bevel pinion working into the bevel wheel, G, on the shaft, C. The first motion shaft has also upon it a pulley, F, the strap from which passes to a small pulley on the outside end of the counter shaft, I, the remaining three pulleys, P, on which, drive the several cutter shafts by their endless straps, the dibber or adzing shaft being driven through the small outside pulley, K. The upper carrying rollers are at L L, the first pair being fluted to hold the wood on entering, as represented at L M in the end elevation. The set of upper transverse shafts, N N, have an eccentric at each end, with connecting links passing from them to the bearings of the upper rollers, which are thus adjustable to suit the different thicknesses of wood—the eccentrics being made to stand at any given point by holding-pins, Y Y, after setting by the cross handle, represented at the end of the machine. The timber is held down upon the plane irons of the bed, U, by the rollers, Q Q; and at R R are other small rollers for holding down the timber on its plate, whilst it passes through the cutter heads and dibber. The index for regulating the shifting cutter heads for different breadths of wood is at T, at the front of the machine. The dibber, V, is capable of being raised or lowered by a screw at each end, connected to a cross shaft by small bevel wheels, worked by the handle, Z. The planing mechanism may be thrown out of gear at pleasure, by the lever handle, W, and levers and weights are fitted for holding down the top rollers upon the timber, a rise of about 1½ inches being provided to allow for any inequalities in the thickness of the wood. The machine is capable of working any description of timber, from ¼ to 3 inches thick, and from 3 inches to 12 inches broad, running through at the rate of 50 lineal feet per minute.

CHIMNEY CLIMBING MACHINE.

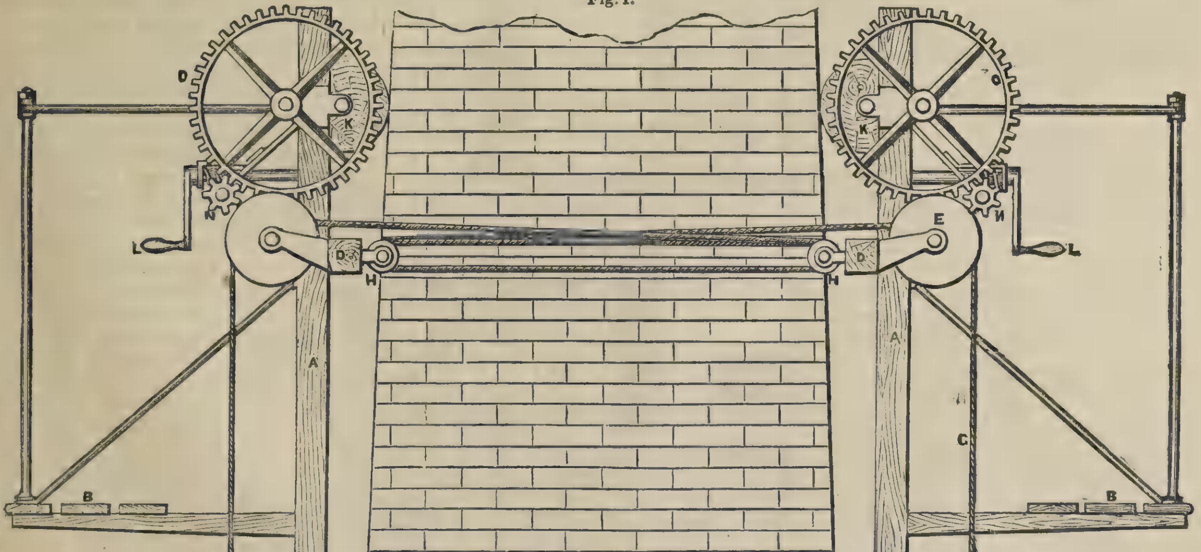
The ascent of the modern chimneys, technically named "stalks," of our manufactories and chemical works, for examination and repair, must always be a somewhat hazardous feat, whatever amount of assistance may be rendered by mechanical contrivances; but as the operation is not unfrequently a matter of positive necessity, we must avail ourselves of all that science may suggest to diminish the attendant risk. The enormous height of many late erections of this class—as that of the St. Rollox Chemical Works here, the Gas Works chimney in Edinburgh, Messrs. Muspratt's at Newton, in Lancashire, and Messrs. Dixon's at Carlisle—has drawn increased attention to the subject of climbing apparatus; and as the latest scheme which

Fig. 2.



½ inch = 1 foot.

Fig. 1.



½ inch = 1 foot.

appears to offer any practical advantages in point of safety, we have now to present one devised by Messrs. Yule and Wilkie, engineers, of this city, who have made and tested the machine upon the chimney of their own works at Port-Dundas.

Figs. 1 and 2 of our engravings, respectively represent two elevations of the apparatus, as fitted to Messrs. Yule and Wilkie's square chimney. It is simply a duplex arrangement of a crab winch, carried upon a wooden frame, with a pair of friction-rollers and weight-rope tackle, the apparatus on each side of the chimney being precisely the same. A A, Is the wooden frame, carrying a platform, B, for the climber, with a guard-railing on each side. In commencing the ascent, one of these frames is placed on each side of the base of the chimney, as shown in fig. 1, and the power of adhesion to the surface of the brickwork is obtained by the weights, C C, which, with their rope-barrels, are attached to the ends of the horizontal cross-beams, D, projecting over the sides of the frames. These weights are suspended from ropes wound upon the 12-inch barrels, E E, fast upon the same shaft with the 4-inch barrels, F F, upon which also are wound the two ends of the ropes, G G, passing over pulleys at H H, forming a regular purchase-tackle from side to side of the chimney, so that the opposing weights, which are in this case 56 lbs. each, act so as to draw the upper portions of the frames towards each other. The lower ends of the frames are made to bear partially against the chimney by the central wooden rollers, I I, whilst the upper pairs of wooden rollers, K K, bear hard upon the brickwork surface, to give the required adhesion for holding the machine at any point.

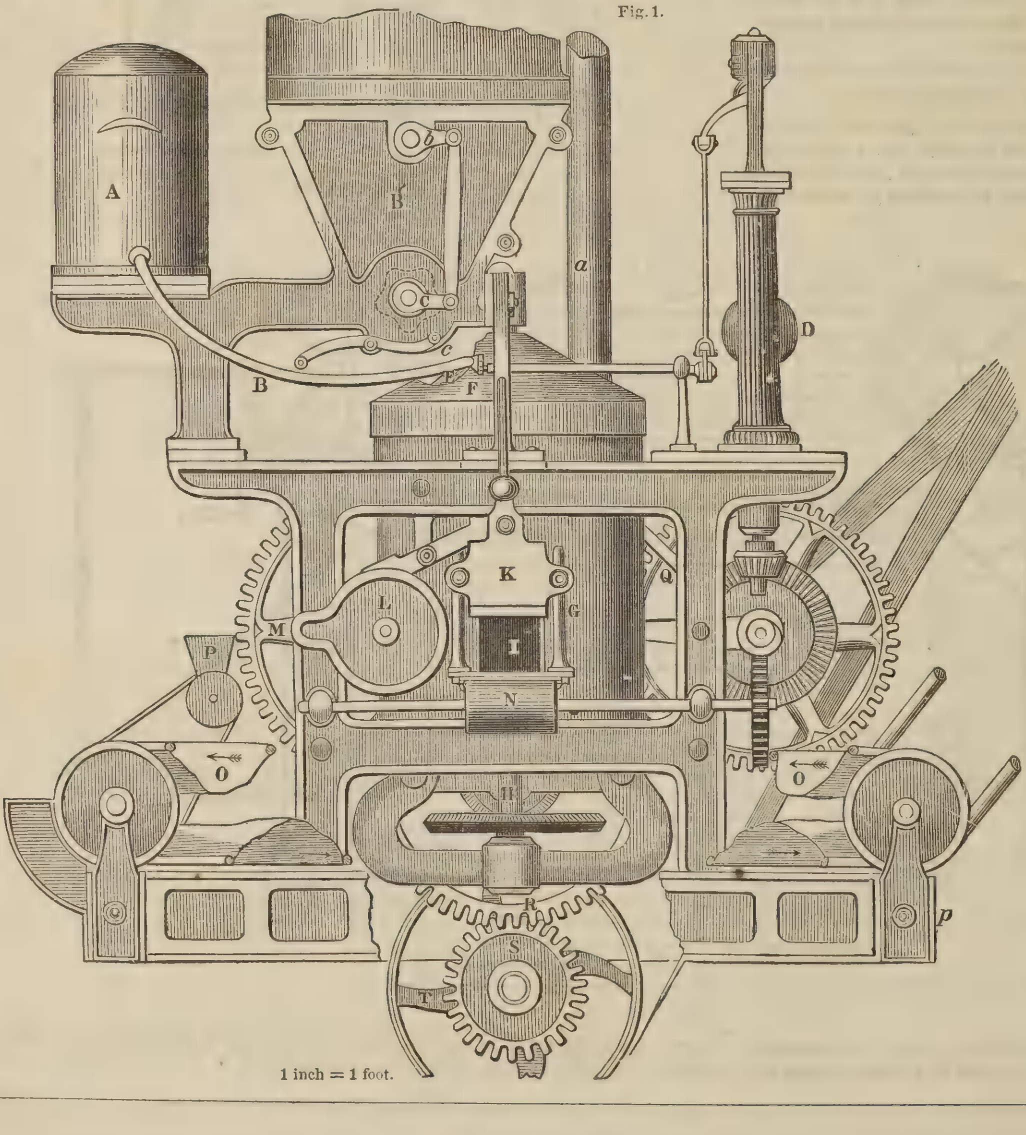
The operation of climbing is accomplished by two attendants, one on each platform, who work the frames in concert, up or down, by the handles, L L. These handles are, in each, fast upon a worm-shaft, the worm of which drives a wheel on the cross-shaft, M, carrying at one end a spur-pinion, N, in gear with the wheel, O. This wheel is keyed on the end of the upper cross-shaft, the opposite end of which carries a pinion, P, driving a wheel upon the shaft of the pair of wooden friction-rollers, K, which, in their revolution, raise or lower the whole machine by their adhesion upon the surface of the chimney. By driving the climbing gear with a worm, no stop or catch arrangement is necessary, as the winch-handles must be turned by hand before any movement of the machine can take place. It is obvious that, as the machine rises, the large barrels constantly unwind their ropes, drawing the friction-rollers hard up to the chimney, accommodating the hold to the taper of the surface.

The contrivance is applicable to any section of chimney. For an octagon, the modification which we have illustrated, answers as well as for a square; whilst for a round, the only difference will be, that the adhesion-rollers must be hollowed out in their longitudinal centres. Of course, any plain columnar erection may be ascended by this apparatus —the top of our defaced Nelson's column on the Green, for example, might easily be got at by its assistance.

ROBINSON AND LEE'S BREAD-MAKING MACHINE.

We last month gave an outline of the advantages to be secured by the adoption of this important improvement—(see *ante*, p. 251)—and we are now prepared satisfactorily to show our practical readers how the several novelties involved in it are carried out. Fig. 1 of the annexed engravings, is a front elevation of the loaf machine, complete for work. Fig. 2 is a front elevation of the ovens and boiler, the boiler-furnace and two of the ovens being represented in transverse section; and fig. 3 is a sectional plan of the boiler, flues, and surcharging steam-pipe.

Fig. 1.



1 inch = 1 foot.

The carbonated or aerated water, used as a substitute for the ordinary yeast, or barm, is contained in a fountain, A, on a bracket at the back of the machine. This fountain is supplied with the fluid from a separate reservoir, in such a manner as to maintain a uniform rate of pressure within it suitable for the exigencies of the machine, which derives its supply from it by the pipe, B. The flour-hopper is at B′; it has in it a horizontal spiked bar, or shaft, *b*, arranged to work with a compound movement, partly lateral and partly revolving, being connected by a crank and link to a second crank of similar size, carried on the end of the flour-feeding roller-shaft, C, so as to obtain the requisite movement for giving the flour in the hopper a light, even, and unintermittent delivery to the feed-roller. This roller is of wood, and is fluted or grooved, as represented by the dotted lines, and has a clearing wire, *c*, bearing against its under surface, to prevent the flour cohering. This portion of the machine is also applicable for feeding purposes in grain-mills, and for other uses, where a uniform feeding action is necessary, its peculiar object in the present case being the prevention of the clogging hitherto found so objectionable in flour-mills and bakeries, and the securing a more complete system of amalgamation of the component materials of bread.

For the regulation of the supply of materials, the governor, D, is used, its sliding ring at the top being made to act upon a horizontal spindle working a stop-cock in the end of the liquid supply-pipe, B. E, Is the mixing cone of hard wood, furnished with a cover, F, of galvanized iron, and having a scraper of the same material on its under surface to guide the half-formed paste into the kneading-mill, or drum, G, which is a cylinder or drum of hard wood, 1½ inches thick, with twelve horizontal arms fixed in it at regular intervals, so as to allow the passage between them of similar arms on the kneading-shaft, H. This shaft is carried in top and bottom bearings, and works through a stuffing-box in the bottom of the drum, the mixing cone being keyed upon its upper end; its revolving arms are set at an angle of about 30° in an opposite direction to those on the drum. A short brass tube, I, is screwed to the side of the drum, over an aperture formed in the latter, as a port-hole for the escape of the dough, which, as it exudes, is cut off into pieces of the proper size for the intended loaves by the vertical sliding knife, K. This knife receives motion, at the required intervals, from a lever, carrying on its shorter end a stud working in a groove in the back of the cam, or guide-wheel, L, the speed of which is capable of regulation by the change-wheels, M. On the delivery of the dough from the mill, it is conveyed by a wooden roller, N, to the moulding frame, O, the roller being driven at a slow rate by a worm gearing with a worm-wheel on the end of its shaft.

The moulding frame consists of a frame with two concave pulleys and an endless cloth, part of which last is removed in our engraving to show the lower gearing. The cloth is traversed by bands, or pitch-chains, upon the concave pulleys, beneath the dredging-box, P, in which a revolving circular brush keeps the cloth and its piece of dough under conveyance well dusted with flour. In the return movement of the cloth, it passes over a fixed block of wood, *p*, hollowed out on its upper side, to form, with the contour of the pulleys, a complete cylindrical opening, or passage. Through this passage the dough is conveyed, as represented by the arrows, being rolled or pressed in its transit into a ball or globe, ready for conveyance to the oven by the baking truck. When biscuits are made, this moulding frame is removed, and the dough, on issuing, is conveyed at once to the cutting-out machine.

Although the patentees claim the use of aerated water as a substitute for barm in bread-making, the machine is yet quite applicable for use in the fermenting process. In this case, instead of supplying flour from the hopper, the material, in the form of a "half sponge," is conveyed by the vertical tube, *a*, the feed being regulated by the governor as before. The gearing of the machine demands little explanation. The oblique shaft, A, worked from the gearing beneath the governor, drives the flour-feeding roller; the whole being put in motion by the main-pulley shaft, carrying a spur-wheel, S, gearing with the wheel, R, which runs at the rate of 30 revolutions per minute; at which velocity the machine we have described will produce a ton and a half of loaf-bread, or a ton of biscuit per hour. Of course, by a slight variation in the gearing, the machine may be driven by hand.

The baking operation is carried on in steam-heated ovens, shown in fig. 2. The ovens, arranged four together, U U, are built up with a steam-boiler between the two pairs, one of the pairs being proving or raising chambers, into which the fermented or barm bread is first placed on commencing to bake. They are heated by flat rectangular steam-chests, forming their top and bottom. The other pair are steam-ovens, heated by coiled pipes, as at X, which pass through the boiler furnace under a protective covering of fire-tiles, and are kept at a red heat. After the steam from the boiler, W, has heated the chambers in the first pair, it is passed through the coiled pipes, X, by which means it is surcharged with heat, without acquiring any additional pressure, and in that state is blown into the ovens—shown in section by the pipe, Y, having discharge branches, Z Z—acting directly upon the dough contained in them. To carry off the steam and vapour, trumpet-mouthed tubes are placed in the tops of the ovens, and in connection with an external vertical pipe, which conveys the discharge to a condensing receiver, where, when quite cold, the matter blown out is charged with carbonic acid gas, with the addition of salt, for the supply of the aerated liquid fountain. To afford the necessary means of regulation of the heat of the ovens, the patentees employ a species of pyrometer, or, as it may be termed, a heat-regulator. This acts on the principle of the copper-rod pyrometer applied some years ago by Mr. Holdsworth, for showing the heat in steam-boiler furnaces; but here it is not a mere indicator, as it is a self-acting regulator in itself. In the side of the oven next to the boiler are two brackets or studs, 1 and 2, into one of which a copper rod is securely fixed at its end, resting loosely in a collar in the other. This loose end projects through a hole in the oven front to a vertical lever, 3, connected to a second horizontal one, 4, and the expansion and contraction of the copper rod acts, through these movements, upon the index lever, 5, a link from which passes upwards to a bell-crank, acting upon a valve, 6, in the steam ingress valve.

Fig. 2.

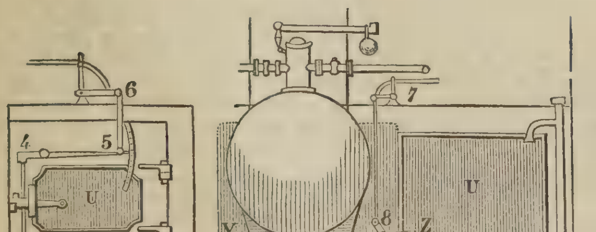
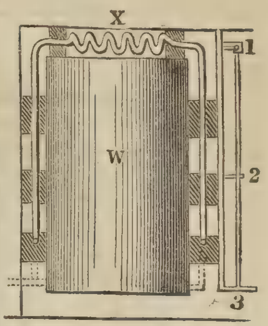


Fig. 3.



Mr. Lee is at present engaged in London, in erecting and getting to work an extensive establishment in Wapping, for carrying out his improvements. The movement is a most important one, and deserving of all the interest which attaches to the successful substitution of a philosophical for a crude uncertain process.

THE MECHANIC'S LIBRARY.

Architect and Building Gazette, Vol. I., 1849, folio, 17s. cloth.
Art amongst the Greeks, Ancient, 8vo. 12s. cloth. Winckelmann.
Builders' Price Book for 1850, 8vo. 4s. sewed. Crosby.
Design and Manufactures, Journal of, Vol. II., 8vo. 7s. 6d. cloth.
Facts, Year Book of, 1850, 12mo. 5s. cloth. J. Timbs.
Geography, Mathematical and Physical, 12mo. 3s. J. B. Caulfield.
Limes, Cements, &c., Treatise on, 12mo. 1s. (Weale.) G. K. Burnell.
Philosophical Conversations, 3d edition, 12mo. 5s. cloth. F. C. Bakewell.
Practical Mechanic's Journal, Vol. II., quarto, 14s. cloth. Johnson.
Signals, Complete Dictionary of, 18mo. 8s. 6d. cloth. Wilmot.
Trigonometry, Elements of Spherical, 12mo. 1s. (Weale.) J. Hann.
Westminster, Illustrations of New Palace of, 1st series, £1 12s. Barry.

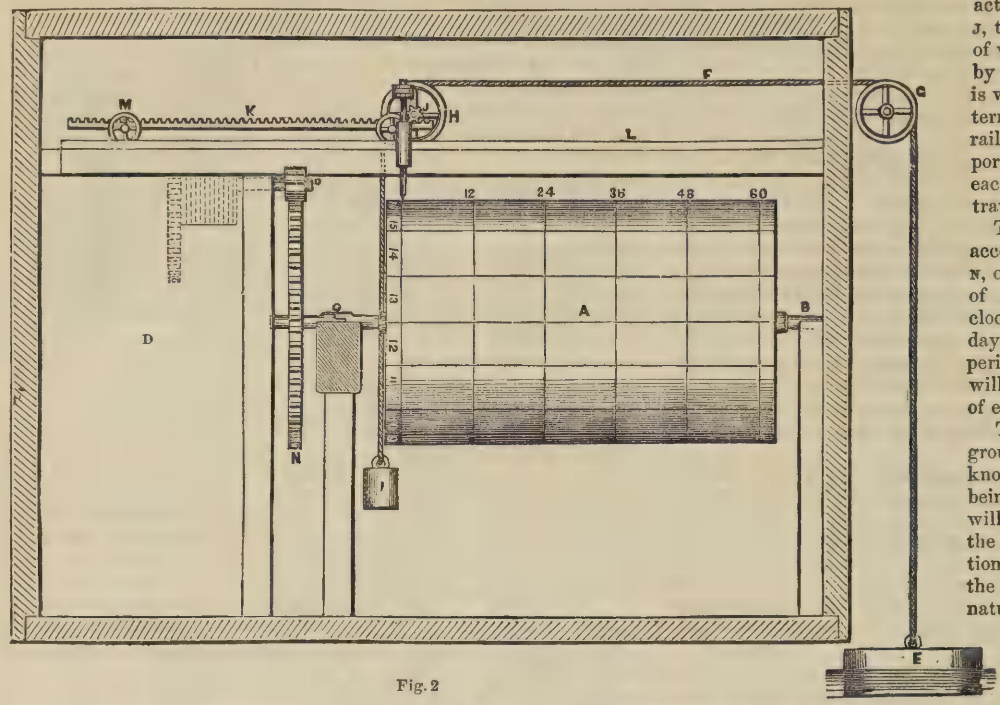
SELF-REGISTERING FLOOD GUAGE.

It is a confessedly difficult matter to measure, with anything approaching to accuracy, varying and intermittent discharges of large quantities of water; in fact, all the means we have at present at our disposal are very poorly calculated to give anything better than a very rough average of the passing current. The self-registering guage, which we illustrate in the present article, aims at something more. The particulars of it have been supplied to us by Mr. J. N. Gale, civil engineer of this city, who proposes to apply it at the Gorbals Water Works, near Barrhead, for the purpose of showing, in a simple manner, the actual quantity of water passed off from the reservoirs.

Fig. 1 is an elevation, and fig. 2 is a plan, of the apparatus, as contained in a rectangular box. A, Is the index cylinder, 32 inches in circumference, made of thin sheet-copper. It is carried horizontally, in bearings, at B and C, being coupled at C to the gearing in connection with the regulating clockwork, occupying the space, D. It is covered with paper, to receive the tracings of the index pencil, and this paper is divided, circumferentially, into 384 spaces, each denoting one hour; whilst it has, in addition, 240 longitudinal divisions, each representing ¼ inch, as in fig. 3, which shows a portion of the divided paper, with an indicating curve upon it.

In the case of the Gorbals works, the guage is placed upon the burn or streamlet conducting the water to the filters, the varying water-level acting upon it through the float, E. This float is hung to a cord, F, passing over a guide-pulley at G, and thence twice round the grooved pulley, H, ending in a counterweight at I. The rise and fall of the water-level acts correspondingly upon the pinion, J, through the pulley, H, upon the shaft of which latter the pinion is fast, and by this pinion the horizontal rack, K, is worked. This rack traverses, in alternate directions, upon the two grooved rails, L L, into which the small supporting wheels, M, are fitted, and for each foot of rise or fall of the water it traverses three inches.

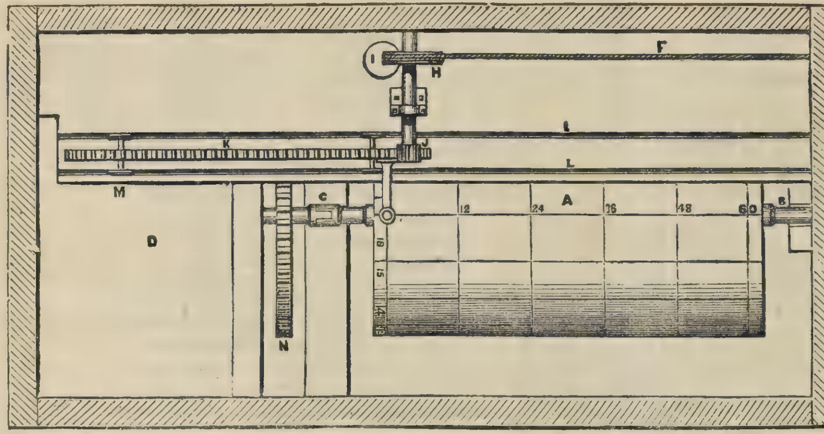
Fig. 1.



The cylinder, A, is caused to revolve according to time, by the spur-wheel, N, of 200 teeth, driven by the pinion, O, of 10 teeth, in connection with the clockwork barrel. The clock goes 16 days for each winding up, and at the periodical windings the index cylinder will also be changed, say on the 16th of each month.

The extent of the contributing ground or catch-water basin being known, and correct accounts of the fall being kept at various points, this guage will give us the power of determining the quantity of water lost by evaporation and absorption, with reference to the different seasons of the year. The nature of the soil, and general inclination of the surface, must be taken into account; but a correct result in one particular case will afford data to serve as a guide in others.

Fig. 2

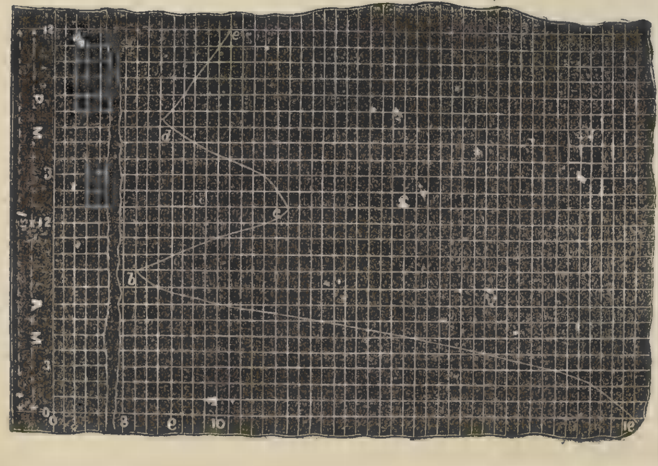


In the diagram, fig. 3, is given an example of a line of heights marked by the tracer during 24 hours; the points marked *a*, *b*, *c*, *d*, and *e*, being the heights of the water actually observed on the 1st of February.

If we suppose that the water, in flowing past, generates a solid of the form of a simple prismoid, it will be sufficiently accurate to take the mean of two heights, whose difference is one inch, and the multiplication of the observed velocity of the stream at this depth, by the time, gives the length of the prismoid, and having its height at each end, and the breadth of the water-way, its solidity can at once be found.

According to the diagram, the depth of water in the stream at 12 a.m. was 19 inches; during the period of two hours it fell to 18 inches, the mean being 18½ inches. The observed mean velocity at this depth was 265½ feet per minute, which multiplied by 120, the time in minutes, gives 31,860; and 18½ inches × 20 feet × 31860 feet = 982,560 cubic feet of water, as the quantity passed in two hours, 20 feet being the width of water-way. In this way it will be found that the total quantity, according to the line traced in fig. 3, is 5,499,900 cubic feet, run to waste on the 1st of February. By arranging the depths, velocities, and times, in a tabular form, the necessary calculations are readily made.

Fig. 3.



RECENT PATENTS.

TURNING AND CUTTING WOOD.—Findlay & Wilkie, Paisley.—*Enrolled Feb.* 9, 1850.

Messrs. Findlay and Wilkie's improvements bear most importantly upon the turning or manufacturing thread bobbins, or other articles, of which a great number of the same kind are required, as the small bobbins, of which such vast quantities are used in the Paisley and Glasgow thread factories.

The machine employed for turning these bobbins, resembles an ordinary lathe in its chief details. The fixed headstock carries a small arbor, or holder, for the rough blanks, which are bored out and slipped upon it, by the sliding centre bar of the opposite or adjustable headstock, worked by a lever set transversely across the machine. Between the two headstocks upon the bed of the machine, are placed the supporting plates of the pair of tool-holders, which vibrate on centres, so as to cause their cutters to traverse up to and from the revolving blank. The back cutter is plain, and simply smooths down the blank to a plain cylinder, when the front compound cutter turns down the recess for the thread, and finishes the ends of the bobbin. The requisite traverse for the tool-holders is obtained from a transverse shaft passing beneath them, and carrying a pair of cams, which work up against the lower surface of the holders.

The transverse shaft is driven by a separate strap pulley, the shaft of which has upon its end a crank lever, connected by a rod with a lever on the corresponding end of the shaft. The movement of the pair of cutters is so contrived, that whilst they both move together for a considerable distance towards the blank, yet the roughing cutter performs its work first, its cam or actuating pin being made to pass slightly beyond its highest point, to allow the tool to recede after its cut, when the finishing tool comes into action and completes the bobbin. Both tools afterwards expand, and leave the finished bobbin to be drawn off by a slide, worked by the lever which adjusts the blank in its place. The same lever also actuates a disengaging clutch on the pulley shaft which drives the tool-holders, so that the motion of the latter is stopped at the instant that the finished bobbin is removed, in order to allow the attendant to put on the succeeding blank.

Instead of driving the tool-holders by a plain crank lever, a cam action may be used, so as to give a quick traverse up to the cut, with a slow cutting action.

The patentees show several modifications of their mechanism, and claim—

1. The general construction and arrangement of the machinery or apparatus described, and its application to the cutting and shaping of wood and other suitable materials into bobbins, and other articles producible by such machinery.

2. The system or mode of cutting or shaping the substances from which bobbins and other articles are to be made, wherein both cutters traverse simultaneously towards the material to be shaped, for a considerable portion of their stroke, the plain or roughing cutter or tool being made to come into action slightly before the finishing tool.

3. The adaptation or employment of a stop or disengaging apparatus, for the purpose described.

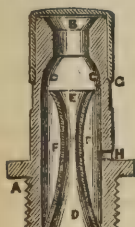
4. The system or mode of traversing the cutters in such manner, that their rate of movement shall be slower at the instant of cutting, than during the period of their traverse to or from the material to be cut.

REGISTERED DESIGNS.

WATERPROOF GUN-NIPPLE.

Registered for Mr. Thomas Kennedy, *Gunmaker, Kilmarnock.*

Moisture, as affecting the certainty of firing, is the sportsman's most dreaded enemy; and although the substitution of the percussion for the old flint-lock has, with its other numerous advantages, done much to alleviate the miseries attendant on dampness, still the enemy will sometimes make its appearance. Mr. Kennedy of Kilmarnock, who has had the honour of the commendations of Prince Albert for the ingenuity and efficacy of his contrivance, has lately introduced a modified nipple, which appears to accomplish all that can be done for the prevention of the evil. The arrangement has for its object the prevention of the access of moisture to the powder in the nipple or breech of the piece, as well as to the detonating composition in the percussion-cap. Our engraving represents a vertical section through the centre of a detached nipple, as fitted with a cap ready for firing. The figure is twice the real size. The nipple screws into the breech of the gun in the usual way, resting upon the seat or flange-ring, A. The top of the nipple, in place of being formed with a plain, conical, or cylindrical aperture, is bored out with a slight cone at B, beneath which it is cylindrical, finally expanding at the part, C C, to the full size of bore, which is carried down to the bottom. A second nipple, or conical tube, of platina, D, is placed in the interior of the nipple, and concentric with its bore, the bottom flange of the inner tube resting on the breech, so as to be held firmly down by the bottom of the percussion nipple, when the latter is screwed into its place. The bore of the internal nipple diminishes rapidly upwards until near the top, where it is expanded upwards as at E. With the nipple thus arranged, any moisture collecting at the top, at B, passes down the interior of the nipple into the space, F F, being kept from contact with the powder by the internal nipple, and the igniting effect of the exploding composition of the cap is directed by the cone, E, in a most effectual manner, upon the powder passing from the breech into the internal nipple.



Double real size.

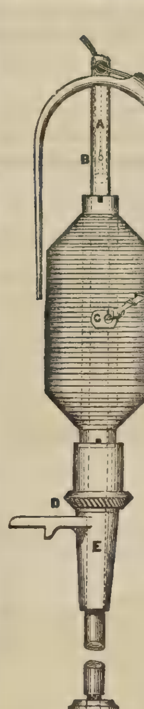
The percussion-cap does not rest upon the top of the nipple when first placed on, but is supported by its lower edge, G, which rests on a small ledge formed round the outside of the nipple, so that the percussive composition in the interior of the crown of the cap is kept slightly above the top of the nipple, until the hammer strikes it. In this way the explosive composition of the cap will not come in contact with any slight moisture which might accidentally be on the top of the nipple. Any water, or foreign matter, getting into the space, F, escapes by a small aperture at H, in the bottom of the nipple, answering also as an air-escape.

The invention has been found to answer excellently in practice, as it is next to impossible for the least moisture to touch the powder. The inner tube, too, directs the fire well upon the powder, and, being of platina, it is indestructible.

SPINDLE AND FLYER.

Registered for Mr. Isaac Whitesmith, *Machinist, Glasgow.*

In Mr. Whitesmith's spindle and flyer, the improvements contemplated are—the obtainment of a better coupling between the spindle and flyer, with a more elegant, stronger, and lighter shape of the latter, together with an advantageous shortening of its arms; as also an easier descent for the roving along the bend of the flyer, the shortening of the upper portion of the spindle, and the prevention of the accumulation of waste beneath the bobbin-end, with additional steadiness of movement of the whole mechanism. Our engraving represents an elevation of a roving spindle, bobbin, and flyer, with the spindle collar or bearing, and the two pinions for the spindle and bobbin motions. The coupling between the flyer and the spindle is effected by a projection, A, represented in dotted lines, as formed upon the flyer, and entering and fitting to a hole bored out in the top of the spindle to receive it. The projection, or entering piece, A, is split up the centre, so that when the flyer is in its place, the split end of the projection enters upon a pin passed transversely through the spindle at B. Should any wear ensue between the projection and its socket, the looseness is easily remediable by slightly widening the split in the projection. This arrangement admits of the transverse of the bobbin quite up to the top of the flyer, and the spindle and flyer are both shortened to the extent thus gained.



1-4th.

The upper curved portion of the flyer, in place of being flat, with sharp turns downwards, is made with a regular curve to give increased strength, as also in effect to shorten the arms, and give an easier descent to the roving; and the flyer arms are still further shortened by bending downwards the presser, C, giving also here an easier passage for the roving.

The top of the pinion, D, is slightly countersunk to receive the end of the bobbin, the object being to prevent waste from collecting between the bobbin and its end bearing, as well as to remove the chance of the bobbin rising out of its place during the descent of the bobbin-rail.

The collar-bearing, E, of the spindle is carried upwards for a short distance into the boss of the pinion, D, to secure greater steadiness.

The whole of these modifications evidently tend to the obtainment of great additional lightness and security to those parts most liable to derangement from vibration.

REVIEWS OF NEW BOOKS.

Notes of Experiments, with Thoughts on Electricity—Hydrogen obtained from Water without Oxygen—Smee's Mechanical Principle applied to the Common and other Voltaic Batteries. By Charle

Chalmers, Merchiston. Pp. 29. Woodcuts. Edinburgh: Sutherland and Knox. 1850.

Mr. Constable's printing, seconded by some admirably-executed wood engravings, has given Mr. Chalmers' pamphlet the full benefit of an elegant exterior; and we must, at least, accord to its pages the superficial merit of being, in a truly literal sense, a superior sample of the bookmaker's art. As to the writer's own share of the production, we have a different tale to tell; for we are not at all prepared to admit the conclusiveness of the experiments which he brings forward in putting his "thoughts" into tangible form. His great aim appears to be to promulgate a new hypothesis, to the effect that—"When a compound body is decomposed by electricity, we do not obtain the constituents of that body, but new compounds, the two electricities—positive and negative—having respectively combined with the constituents of the body which has been decomposed. Thus, in the decomposition of potassa by electricity, we do not obtain the constituents of that body, but new compounds—one of the constituents having combined with positive electricity, oxygen being the product; the other constituent of potassa having combined with negative electricity, potassium being the product." After citing some other common experiments, such as the decomposition of neutral salts by electricity, and the transfer of alkalis and acids to their respective poles, explaining them according to the same rationale, our author proceeds to elucidate a complicated mode, invented by himself, for disuniting "positive electricity from oxygen, and negative electricity from potassium." Out of his own book, however, we have to condemn his deductions; for, amongst all the experiments detailed, we do not trace one satisfactory result—that is, satisfactory in its bearing upon the line of argument laid hold of.

No. 1 being marked upon the cover of the pamphlet, we have, as a matter of course, to look forward to the appearance of No. 2, *et cetera*. Before saying more on the subject, it may perhaps be worth Mr. Chalmers' while to prosecute his experimental tests in such a manner as to evidence the accuracy of his theories in a clearer light than his first 29 pages seem to afford. No one will dream of giving up the generally received opinions on such slender grounds as we find here.

Causes of the Explosions of Steam-Engine Boilers Explained, and Means Suggested for their Prevention. By W. Stewart, C.E. Second Edition. Pp. 12. London: Longman. 1849.

The readers of the earlier volumes of the *Practical Mechanic and Engineer's Magazine*, will remember Mr. Stewart as a valuable correspondent of that work. The present little production is a second edition of a reprint of a paper, read before the Philomatheque Society of Bordeaux, in 1841, in which paper the author enumerates and adds his comments upon seven varieties of explosion.

Most of our readers are doubtless already in possession of the subject-matter of the pamphlet; those who are not, will find some shrewd and interesting remarks in its pages.

An Account of Several Entirely New Patent Processes for Purifying the Waters of Cities, Towns, and Private Dwellings. By John Horsley. Pp. 28. London. 1849.

Mr. Horsley is favourably known as the inventor of some important improvements in the purification of water, and in the prevention of boiler incrustations, of which the pages before us are a succinct exposition. His invention is based upon the principle of removing, by chemical means, chemically suspended impurities, in contradistinction to the many mere mechanical remedies of the day. We shall here give an extract from the specification, promising to resume the consideration of the plans laid down in it next month:—

> "For removing incrustations, I first purify the water to be used in boilers in the same manner as that described with regard to water intended to be used for drinkable and other purposes; and where sea-water is employed for generating steam, I purify such sea-water in a similar way, by employing the oxalate of potassa, hereafter mentioned, and ammonio-phosphate of soda; and the proportions I employ for the water of the British Channel are about two drachms of oxalate of potassa to about two ounces of the ammonio-phosphate of soda for every gallon; but these proportions may be varied as circumstances may require, having regard to the principles hereinafter set forth. The precipitate resulting from the employment of the substances above stated, forms an admirable fertiliser for wheat and other grain, and therefore need not be changed or altered by decomposition for the sake of recovery, as in the cases hereinafter set forth.
>
> "With regard to purifying, filtering, and otherwise rendering water fit for drinkable purposes, I would remark, that all water, except distilled water, is more or less charged with various adventitious, earthy, saline, and gaseous matter, acquired by transit through the soil, which imparts thereto that peculiar hardness, recognisable on the use of soap, in some cases from its being curdled, as well as its becoming chalky, and depositing or crusting, not only when boiled, but also from various unassignable causes when not boiled; all which qualities render the use of such water, for various purposes in household economy, and the arts and manufactures, highly objectionable. It is well known that there are certain chemical materials, tests, and re-agents, which sensibly indicate the presence or absence of the aforesaid adventitious matter, forming therewith insoluble precipitates, and this may be extended and applied to the purification and separation of such earthy and saline adventitious matter from the water in which the same is contained; such purification and separation to be conducted upon the principle of either single or double elective chemical affinity, commonly known to chemists, or, in other words, by a system of displacement, based on the nature and theory of chemical equivalents, or the knowledge of the parts and proportions in which these several substances unite, and are held in solution.
>
> "In order to accomplish the separation of the calcareous matter, which is more generally found in water than any other matter, I employ, for that purpose, such substances as are capable of decomposing the same—namely, calcined or caustic barytes, or a solution of the same in water, known as baryta water; the baryta uniting with the excess of carbonic and sulphuric acids of the salts of lime, decompose and precipitate the same along with the lime, in the form of carbonate of lime, carbonate of barytes, and sulphate of barytes. When phosphate of soda, which is composed of soda as a base, united to phosphoric acid, is added to water containing lime, the phosphoric acid unites with the lime to form the insoluble precipitate of phosphate of lime. When silicate of potassa, which is composed of potassa as a base, united to silicic acid, or acid of flints, the silicic acid uniting with lime to form an insoluble silicate of lime, oxalic acid, or acid of sugar, and its soluble alkaline, salts, oxalate of soda, oxalate of ammonia, oxalate of potassa, sesqui-oxalate, or binoxalate of potassa, any of which substances unite with lime to form a precipitate of oxalate of lime, caustic strontia, or strontia water; I give the preference, however, to the oxalate of potassa, when it is designed to extract the whole of the lime."

CORRESPONDENCE.

STEAM-BOILER WATER-GUAGE.

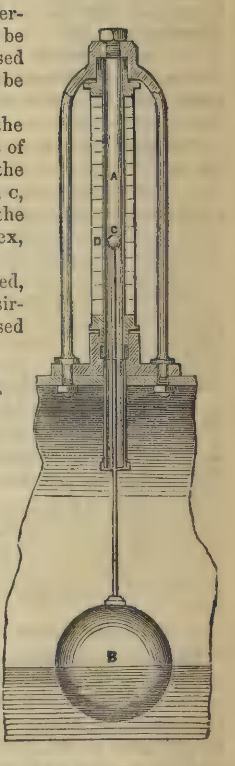
I beg leave to enclose to you a sketch of a water-guage for steam-boilers, which, I think, might be conveniently used, when, the boiler being encased in brickwork, the ordinary guage cannot well be applied.

A, Is a glass tube fixed in the usual way, the top being supported by the junction of a couple of pillars bolted to the top of the boiler, and the copper ball, B, carries a rod with a small knob, C, at the top, which, passing up the interior of the tube, indicates the height of water on the index, D, graduated in inches.

When a feed-regulating apparatus is required, the float and balance-weight is of course desirable; but when this is not wanted, the enclosed plan might be adopted with advantage.

John G. Winton.

Cherry Bank, North Leith,
Jan. 17, 1850.



1-8th.

ROBERTS' VENTILATING FLOWER-POT.

In this modification of the ordinary flower-pot, the object which I have sought is two-fold—first, to effect perfect drainage for the flower or plant; and, secondly, to give air to the roots, and, I may add, food also, by capillary attraction. Another little point to be noticed, is the facility of looking into the pot to see whether the food applied is congenial to the plant. If so, the roots will strike into it; if otherwise, they will recoil and run from it. The principal food of all plants is carbonic acid gas and moisture; therefore, I contend that if any decaying matter in solution be placed in the bottom of the pot, slow combustion will take place, and carbonic acid gas will be generated, necessarily nourishing the plant more rapidly and effectually than by any other means. But as some plants are exceptions to this rule, ammonia, phosphates, and sulphates, may be tried to convey nitrogen in excess; but these are more applicable to grain and similar plants, from which seeds are desired. I am this season making experiments on a variety of plants, and hope, at the close, to be able to state the result of my search.

The "ventilating pot" is outwardly of the usual shape. About two inches above the bottom are two opposite parallel holes, in either of which a liquid may be placed by a watering-pot; the usual central hole in the bottom is to be corked up, and only opened when it is necessary to do so for cleansing. Inside is placed a horizontal circular disc, fitting to the pot, and standing upon short feet, standing up just above the level of the two side holes. The disc is perforated with a number of small holes, and thus acts as a perfect drainer.

John Roberts.

Eastcheap, London, February, 1850.

QUERIES ON THE ELECTRIC TELEGRAPH.

May I beg the favour of your answering the enclosed questions in the next number of your Journal? I am not sure that I have expressed myself in the clearest manner, but I have endeavoured to do so to my utmost ability:—

1. In the formation of Q and Z in the telegraphic needle instruments, which letters are produced by an opposite application of the galvanic current to each needle, why should one *terminal* and all *intermediate* instruments be able to produce those opposite movements simultaneously from a single set of batteries, and yet the remaining terminal instrument be unable to form a similar deflection of the needles signifying those letters?

2. It is well known by those familiar with the manipulation of the electric telegraph, that whenever a Q or Z is formed with the "double needle" with a single set of batteries, the strength of the deflections at the distant station is greatly inferior to the force of deflection when a parallel movement of the needles is effected, although the same power acts for both. Why should this be? If the galvanic battery really contains two currents—positive and negative—why should the amount of deflective power, when those currents are divided and each applied to a separate needle, vary from the deflective power of an equal division of *one entire current*, as is the case when the needles assume parallel directions?

3. And again, why should one terminal instrument, whose centre connections are formed in the reverse order to the corresponding terminal instrument, be unable to form the signals Q and Z with equal facility as the remaining instruments in connection with the line of wire; and if on the theory that there is only one current of electricity generated in the battery, why should the deflections of the needles be weaker when the current is transmitted simultaneously in opposite directions through the coils, than when transmitted simultaneously in like directions?

Electric.

[We are afraid that our correspondent's diffidence of his explanatory powers arises from good and sufficient reasons, for we, at least, are at a loss to discover his meaning.

There are various kinds of the needle telegraph, and a still greater variety of arrangements of the coils, needles, and conducting wires. In some cases, the earth is made to form a part of the galvanic circle; in others, it is not. In some positions, the magnetic needle, when under the influence of an electrified wire, is not so much deflected as in others, in consequence of the terrestrial magnetic effect, especially when actuated by a weak current.

In the latter portion of the second question, there is either some error in writing, or the writer must himself be profoundly ignorant of the acknowledged electrical laws. He speaks of dividing the current into positive and negative—applying each to a separate needle! In the name of Oersted, Franklin, and Snow Harris, what is this? Who ever heard of the separation of electricity into two streams, as if the subtle fluid were compounded of oil and water. Oersted has shown us, that when a magnetic needle is brought near the connecting medium of a closed galvanic circle, it is immediately deflected from its natural position, and takes up a new one, depending upon the relative positions of the wire and needle. If the connecting medium is placed horizontally over the needle, that pole of the latter which is nearest to the negative end of the battery always moves westward; if it is placed under the same pole, it moves to the east. If the connecting wire is placed parallel with the needle—that is, if it is brought into the same horizontal plane in which the needle is moving, no motion of the needle takes place in that plane, but it exhibits a tendency to move in a vertical circle, the pole nearest the negative side of the battery being depressed when the wire is to the west of it, and elevated when it is placed on the eastern side. In no case is the needle affected in the slightest degree, except by a closed galvanic circle. Our querist must try his hand again, somewhat more explicitly, before we can say anything further.—Ed. P. M. Journal.]

WHO INVENTED PARKER'S WATER-WHEEL?

I observe, in the last number of the *Civil Engineer and Architect's Journal*, an article copied from the *American Franklin Journal*, giving an account of what is there called "Parker's Water-Wheel." The improvement claimed in this article is the invention of Koechlin & Co. of Mulhouse, and is patented by them. A description, accompanied with drawings, and several valuable tables, containing the results of a series of experiments made upon two of their wheels, to determine their effective working power, was read at a meeting in August, 1843, of the Société Industrielle. This description, and tables, together with the report of the committee appointed to investigate the merits and conduct the experiments, is published in the Transactions of the Society, vol. xviii.

One would suppose that brother Jonathan would rest satisfied with getting the benefit of all the improvements that take place in machinery and manufactures on this side of the Atlantic, without laying claim to be the inventor of them also.

J. G.

Glasgow, Feb. 19, 1850.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

January 8, 1850.

William Cubitt, Esq., President, in the Chair.

The proceedings of the evening were commenced by an address from the President, on taking the chair for the first time after his election.

After thanking the members for the honour conferred on him, and modestly attributing his election to the fortuitous circumstance of his being "the senior Vice-President in duration of office," rather than to any peculiar fitness on his part, he proceeded to direct attention to some matters relating to the internal policy of the Institution, and proposed that the evening meetings should terminate at half-past nine o'clock, in order to afford an opportunity for the members and visitors to assemble in the library, and to obtain those personal introductions to each other, which constitute one of the great advantages of all societies.

He then announced that the Council had, with great pleasure, acceded to the recommendation of the last Annual General Meeting, and had invited Mr. Walker, Sir John Rennie, and Mr. Field, the past Presidents, to take their seats at the Council table, in the Council-room, and in the Theatre, as "Honorary Councillors," and that, in future, all those members who should fill the posts of Vice-President and President consecutively, holding the latter position for two years, should be considered "Honorary Councillors;" expressing a hope, that the past Presidents might long be spared to continue that assistance from which the Institution had already reaped so much advantage.

He then announced, that, as the representative of the Institution, he had been nominated a member of the Royal Commission, for the promotion of the Exhibition of the Works of Industry of all Nations, under the auspices of H.R.H. the Prince Albert, and requested the aid and cordial concurrence of all the members in that real "Peace Congress."

He then noticed some of the principal engineering works which had been terminated, or had made great progress, during the past years; commencing with the Tubular Bridges across the River Conway and the Menai Straits, which he designated as "pre-eminent for the boldness of the conception, the scientific simplicity of the design, and the difficulty of the execution." He then proceeded thus:—"In tracing the original idea of the most advantageous disposition of a certain amount of material, in a tubular form; the more definite conception of a hollow beam, to permit the passage and support the weight of an engine and train; the experiments for determining the proper distribution of the material, to prevent compression or disruption; the arrangements for the construction and building up these gigantic masses of material; the means of floating them to their situations, and of raising them to their ultimate destination, at an elevation of one hundred and two feet above the sea (at high water of spring tides); we must feel justly proud of possessing among us the man whose comprehensive mind could originate this magnificent design, and so successfully perform a portion of the work, as to leave no doubt of its ultimate accomplishment. The world already duly appreciates this great undertaking, and we should not be behind-hand in testifying our estimate of the hold conception of Mr. Robert Stephenson, in the original idea, his professional skill in the design and execution, his care and caution in availing himself of the talents and experience of Mr. W. Fairbairn and Mr. Eaton Hodgkinson, whose scientific investigations respecting the strength of cast-iron are so well known to the world, and so high lyappreciated by our profession, and his intrusting the general construction and elevation to Mr. Frank Forster and Mr. Edwin Clarke. Upon the merits of all these gentlemen, we may look with pardonable pride and partiality;—their labours speak for themselves."

The advantages which must result from the more general use of wrought-iron were then alluded to, and it was announced that the commission appointed in 1847, for the purposes of examining into the forms and strengths of iron beams in railway structures, had enunciated the opinion, "that any legislative enactments, with respect to the forms and proportions of the iron structures employed therein, would be highly inexpedient."

The Harbours of Refuge now constructing at Dover, and in the Channel Islands, by Mr. Walker, at Portland and Holyhead by Mr Rendel, the Docks at Leith and Grimsby, also by the latter gentleman; the Lighthouses at the Bishop's Rock, by Mr. Walker, and at the Skerryvore, by Mr. Alan Stevenson, were noticed with great commendation, as most important works, admirably designed and executed.

Details were then given of the steam vessels constructed for the Holyhead, the Folkstone, and several other stations, in which the engines of Messrs. Maudslay and Field, Miller, Penn, Seaward, Rennie, Forrester, and others, had been well allied to the vessels built by Messrs. Scott Russell, Miller, Mare, Wigram, Laird, Vernon, Thompson, &c., and had enabled a speed of from sixteen to eighteen miles per hour to be attained; and in conjunction with the railways, the journey between London and

Dublin to be performed in eleven hours—and that between London and Paris to be accomplished in eight hours and a half, giving a death-blow to the onerous system of passports.

The large iron Pontoon, built by Messrs. E. B. Wilson & Co. of Leeds, with a deck area of twenty thousand square feet, to serve as a floating landing-stage at New Holland, rendering the trains of the Manchester, Sheffield, and Lincolnshire Railway independent of the tides and of the muddy shores of the Humber, was described, and the floating landing-stage previously construeted at Liverpool by the President, with a deck area of upwards of forty thousan dsquare feet, was cursorily noticed, and an account of it was promised to the Institution.

The Railway system of the country was next commented on; and it was stated that there were now nearly five thousand five hundred miles of railway completed in Great Britain, at a cost of two hundred and twenty millions sterling, derived from private sources, and expended within the realm, encouraging, in a remarkable degree, productive industry of all kinds, and inducing a revolution in all mercantile transactions and social relations.

The example of England was noticed, in boldly abandoning the finest roads, and adopting, throughout the length and breadth of the land, a network of iron ways, over which, by the aid of steam, passengers and merchandise could be conveyed with a velocity which, at its original proposition, was deemed worse then visionary; which, first filling the Continent with amazement, eventually compelled imitation, and thus would ultimately introduce wants, and consequently civilization, to the most remote corners of the world. "If (continued the President) this be true, we are naturally led to inquire who were the authors of this great revolution? what minds conceived, and what energies executed these vast projects? The reply, gentlemen, must spring spontaneously from you all—the civil and mechanical engineers have been the great actors in this most interesting chapter of the social history of our country."

The junior members of the profession were then addressed as to the opening now offered for the exhibition of their talents, in the various subjects connected with the sanitory question; and *à propos* of the establishment of *Abattoirs*, it was suggested, that the railways afforded great facilities for bringing up large quantities of animal food ready for sale, instead of transporting living animals to be killed in a crowded city, and introducing noxious and unhealthy trades. If this system were adopted, the general prices would be equalized, and all parties must be great gainers by the plan.

The address then concluded, by directing the attention of Railway Companies to the necessity of securing the *highest engineering talent* for the improvement of the mechanical and commercial working of the lines, and the necessity of setting at rest the question of "depreciation"—a desideratum which was felt to be of almost vital importance to railways as an investment.

The address was received with great applause, and was unanimously ordered to be printed and circulated.

The discussion on Colonel Lloyd's paper on the proposed "Ship Canal across the Isthmus of Panama," was renewed and carried on with much spirit.

JANUARY 15.

Mr. F. Lawrence read "An Account of the Blackfriars Landing-Pier." This pier commences on the Middlesex side of the river, to the east of Blackfriars Bridge, at Chatham Place, and continues parallel to the bridge, and at a distance of 40 feet from it, for a length of 185 feet. The body of the pier (exclusive of the head) is supported on four piers, two of which consist of a single row, and two of a double row of piling, forming three spans of 50 feet each, and having about 8 feet headway under them at high water. The floating-barge, or dumby, on which the passengers land, is 100 feet long, and 25 wide, rising and falling with the tide, in grooves at each end, formed by piles, and protected by dolphins. The connection between the dumby and the pier is by a moveable stage, 8 feet wide, and 50 feet long, secured to the pier-head, at one end by a hinge-joint, and the other end similarly connected to a flight of steps on wheels, which moves on a tramway fixed to the deck of the barge. The principal portion of the timber used in its construction was fir; but the whole, whether of fir or oak, was impregnated by Payne's process, those portions below high-water mark being further protected by a coating of Stockholm tar. The whole of the cast and wrought-iron work was galvanized.

The corporation of London had observed the necessity for an improved landing-place so early as 1841; but it was not until a fatal accident occurred in 1844, that any decided steps were taken in the matter; then Messrs. Walker and Burges received instructions to prepare a design, which was approved; and the pier was commenced in March, 1845, and completed in October of the same year, under the superintendence of Mr. Hewett, M. Inst. C.E. The total cost was about £4,000.

The next paper read was a "Description of a Timber Bridge, erected over the river Ouse, on the line of the Lynn and Ely Railway," by Mr. J. S. Valentine, M. Inst. C. E. The total length of this bridge was 450 feet, divided into eleven bays, ten of 30 feet span each, and one over the river of 120 feet span on the square, and 121 feet 6 inches on the skew. This river-opening consisted of three laminated timber-bows, resting upon stone-piers, the material for which was procured from the New Leeds quarries. The dimensions of the bows were—length of chord, 121 feet 6 inches; versed sine, 14 feet 2 inches; and their depth, 3 feet 8 inches; the width of the outer bows was 2 feet 2 inches; that of the centre bow, 2 feet 9 inches. They were formed of fifteen layers of 3-inch deals, abutting upon a cast-iron plate, bolted to the tie-beams, which consisted of two whole timbers scarfed and bolted together. Each tie-beam was suspended from the bows by thirteen wrought-iron rods, 2 inches in diameter, and between these diagonal struts were fitted. Transverse joists, notched on to the tie-beams, extended across the whole width of the bridge; and on these the rail-bearers were laid, the intervening spaces being filled with 3-inch deals, laid longitudinally.

The works were commenced in the autumn of 1846, and completed in October, 1847, the total cost of the superstructure being about £3,744. When tested, by placing three locomotive engines on each line of rails, the total deflection was only three-eighths of an inch.

JANUARY 22.

"On the Periodical Alternations and Progressive Permanent Depression of the Chalk-Water Level under London," by the Rev. J. C. Clutterbuck.

The author began by defining the chalk-water level to be, "the height to which the water rises at any point, or continuous series of points, *in* the chalk, or *from* the chalk in perforations, through the London and plastic clays, above the chalk." The term "Artesioid" was used to describe those wells sunk through the London and plastic clays, in which the water rose from the chalk, or the sands of the plastic-clay formation, above the level of those strata, though it might not rise to, or overflow, the surface of the ground.

Reference was made to papers read before the Institution in 1842 and 1843, in which it was shown, that the chalk-water level was described by an inclined line drawn from the highest level at which the water accumulated in the chalk, to the lowest proximate vent, or outfall—a general rule, which was found to hold good, not only where the water was found by sinking into a permeable stratum, but where, as in the London basin, the water rose from a permeable strata, through perforations in any impermeable stratum above it.

The example treated of in the paper was described by a line inclining at an average of about 13 feet in a mile, from the outcrop of the London and plastic clays, to mean tide level in the Thames, below London Bridge.

The height to which water rose in the Paris basin, from the lower green sand, was adduced in confirmation of that rule.

Before the Artesian well at Grenelle was bored, M. Arago calculated that the water would rise above the level of the soil at Paris, as it rose above that level at Elbeuf, near Rouen.

The height at which the water was found in the lower green sand, near Troyes, being 100 metres above Paris, and 131 metres above the sea, the author found that a line drawn from that point to the level of the sea at Havre (where the green sand cropped out), passed over Paris and Elbeuf at the elevation to which the water actually rose in both places.

A calculation based on the same principle (taking the level of the water in the lower green sand, at Leighton-Buzzard, at 280 feet above the sea), showed, that if the chalk and gault were bored through in London, the water from the green sand would rise 150 feet above Trinity high-water mark.

Passing from the natural to the actual condition of the chalk-water level under London, there was a general permanent depression of from 50 feet to 60 feet below Trinity high-water mark.

Measurements of a well in London, in which the level was seldom disturbed, showed periodical alternations, coincident with the exhaustion and replenishment of the chalk stratum by natural causes, to the amount of 4 feet 6 inches, and a permanent depression of 1 foot 6 inches per annum, or 12 feet in eight years.

Again, referring to former calculations, it was shown that the margin of this depression was extending in a greater ratio towards the north than to the south or south-east. Since 1843, the level was permanently depressed at Hampstead Road, 10 feet; Camden Town, 19 feet; Kilburn, 20 feet; and Cricklewood, 10 feet—the limit of the depression being, in 1843, between the latter places.

Allusion was then made to the influx of water at the point where the Thames passed over the outcrop of the sands of the plastic-clay formation, and the chalk, as a point to be determined by geological inquiry, and connected with observations as to the action of the tides on the level, and the chemical quality of the water in that neighbourhood.

The general conclusion drawn from all these facts was, that the rapidity of exhaustion from Artesian wells under London, greatly exceeded the rapidity of supply; that the amount of defalcation was marked, and could be measured by the extension of a progressive permanent depression, proving that the supply of water from the chalk stratum became each year more precarious, and less to be depended upon, even should there be no addition to the Artesioid wells in and around the metropolis.

In the discussion which ensued, it was shown that only such a supply of water percolated annually through the chalk stratum, as could be accounted for by the discharge from the rivers of the upper district. The results yielded by Dalton's rain-guage, as used by Mr. John Dickinson, were adduced in proof of this position.

The chemical analysis of the water from wells sunk into the chalk, showed the probability of an influx of the tidal water of the Thames, to replenish the vacuum caused by the immense extent of pumping from the London wells.

On the other hand, it was contended, that from the great extent of surface whence the chalk derived its supply, there might be such a surplus store of water as would warrant any amount of pumping for the domestic supply for the metropolis.

JANUARY 29.

The discussion was renewed on the Rev. Mr. Clutterbuck's paper, "On the Alternations and Depressions in the Chalk Water Level under London."

It was contended, that the water in the upper districts of the chalk accumulated in a proportion increasing with the distance from the river, or vent, and fell off, in a corresponding ratio, during its periodical exhaustion, which usually took place between April and November of each year. This alternation of level, which in the upper districts exceeded fifty feet in perpendicular height, would be represented by a line from the lowest vent, rising at an angle to the highest point saturated with infiltrated water. This had been proved by constant observation on wells, at given periods, throughout a certain district; all the springs forming the river proceeded from that source.

From these, and other positions, it was argued, that if water be discharged from a shaft in the chalk, by a power not capable of entirely exhausting it, the rapidity of the reduction of the level would gradually decrease, until it was exactly balanced by that of the supply. This would naturally produce a gradually extending depression of the water in the strata for some distance around; and it was shown to have been the effect produced, by pumping from an experimental well in Bushey Meadows, in August and September, 1840.

It was urged that the real question to be determined was, whether a supply of water, for London, could be obtained from the deep springs in the sand or chalk. Sections and diagrams were exhibited, to show, by the former, that the supposed basin under London was not as had been shown by geologists; and, by the latter, that from July, 1837, to December, 1849, there had been a gradual depression of full fifty feet in the water of the sand springs under London; and in consequence of this serious action, several of the wells had become tidal in some localities, and the water was rendered saline.

At the termination of the discussion, the attention of the members was directed to a serious case of legislative interference, whereby the free exercise of the professional skill of the members of the Institution was now unwarrantably trammelled, and the public service materially interfered with. The introduction of wrought-iron instead of cast-iron into railway bridges was a recent invention of great value, and of which the most celebrated examples were the Conway and Britannia bridges. The same executive authority which had pronounced the erection of these two bridges to be impracticable, had recently declared that a railway bridge, constructed on a similar principle, and of identical materials, was insufficient in strength, although it was much stronger, in proportion to its possible load, than either the Conway or the Britannia, and infinitely stronger than any of the cast-iron girder bridges which had for years adequately performed the public service, and had been by the same authority pronounced to be perfectly safe. The public had thus already been for a month deprived of the use of an important line of railway, by the application of an antiquated formula to a modern invention.

For these cogent reasons, it was considered that the members had a right to request the interference of the Council on the behalf of the profession at large; and they were urged to take such steps, as appeared desirable, for allowing the free development of engineering talent; and, in the words of the report of a recent Royal Commission, removing from "a subject yet so novel and so rapidly progressive any legislative enactments, with respect to the forms and proportions of the iron structures" of railways, which could not fail to be "highly inexpedient."

This proposition was received with acclamation.

Mr. Evan Hopkins's great Geological Sections of the three branches of the Andes were exhibited in the library. They showed about 260 miles, from west to east, from Choco to the river Meta, in the eastern flanks of the eastern branch of the Andes.

FEBRUARY 5.

JAMES SIMPSON, ESQ., VICE-PRESIDENT, IN THE CHAIR.

The discussion was renewed on the Rev. Mr. Clutterbuck's paper, "On the Alternations and Depressions in the Chalk Water Level under London," and was continued throughout the meeting, so that no original communication could be read.

It was contended, that the area of the chalk district, subject to infiltration, for the supply of the springs and streams uniting in the basin of the Colne, could not possibly exceed the original published estimate of 113½ square miles, and that the proportion of water filtrating through for that purpose, was much less than had ever hitherto been estimated, inasmuch as records by Mr. Dickinson's guage was to a much greater amount than those afforded by the guages kept by other experimenters.

It was also contended, that the original position assumed in the paper had not been weakened by the subsequent discussion; that the observations of the chemists had tended to confirm the statement of the probability of an infiltration of water from the Thames. The practical conclusion to be drawn from the observations recorded in the author's several papers were—That the natural drainage and replenishment of the chalk stratum might be traced and accounted for, by observing the alternation of level in various localities, and at different seasons;—that any large quantity of water abstracted from the chalk stratum, at any given point, caused a depression of level around the point of such abstraction;—that in the upper district, any such abstraction of water would interfere with, and diminish the supply of, the streams, by which the drainage of the district was regulated;—and, lastly, that the depression of level under London, by pumping from Artesian wells, had proved that the rapidity of demand already exceeded that of the supply, and that any attempt to draw a large additional quantity for public use, would be attended with disastrous consequences.

It was suggested that, considering the great works of drainage and water supply which were in contemplation for the metropolis, and looking to the essential importance of having accurate and authentic geological information, in order that those great works might be executed on a sound and certain basis, that the geological survey now being carried on by government in a remote district of North Wales, where no urgent need existed for early geological information, and where no new works of paramount importance were in progress or in contemplation, should be transferred at once to the metropolitan districts, with a view to throw light on the real structure, mechanical and chemical, of the deep-water bearing strata, on which opinions so varying and so conflicting had been advanced.

An inquiry was made whether any steps had been taken by the Council, in consequence of the statement submitted at the meeting of Tuesday, January 29, urging the consideration of the manner in which the interests of the public at large, and of the profession, were likely to be affected by the attitude recently assumed by the Railway Commission, in reference to the strength of the wrought-iron bridges used on railways. It was stated that the Council had not as yet taken any decided steps in the matter, but that a course had been suggested, which, being followed, would most probably lead to satisfactory results. After this assurance, the members expressed their confidence of the interests of the profession being in safe hands, and that every step would be taken for insuring their position and professional reputation.

The motion which had been prepared, was, therefore, withdrawn; and the Chairman requested any communications on the subject to be made in writing to the Secretary, who would lay them before the Council.

FEBRUARY 12.

WILLIAM CUBITT, ESQ., PRESIDENT, IN THE CHAIR.

"An Account of the Cast-Iron Lighthouse Tower on Gibb's Hill, in the Bermudas," by Mr. P. Paterson.

The site chosen for this tower was in latitude 32° 14′ N., and longitude 64° 50′ W., being the southern part of the Bermudas, at which point they are most safely approached. It was at first determined to construct the tower with the materials found in the islands; but, after some progress had been made in quarrying and dressing the stone, it was ascertained to be of too friable a nature for the purpose, so that the Home Government instructed Mr. Alexander Gordon, M. Inst. C.E., to prepare a design for a cast-iron tower, similar to that which had been erected from his designs at Morant Point, Jamaica, and which had proved very successful. The form of this tower was that of a strong conodial figure, 105 feet 9 inches in height, terminated at the top by an inverted conoidal figure, 4 feet high, in lieu of a capital; its extreme outside diameter was 24 feet, at the narrowest part 14 feet, and at the top 20 feet. The external shell was constructed of one hundred and thirty-five concentric cast-iron plates, having inside flanges, and varying in thickness from one inch at the base to about three-quarters of an inch at the top. In the centre of the tower there was a hollow cast-iron column, eighteen inches in diameter in the inside, and of three-quarter inch metal, for supporting Fresnel's dioptric apparatus, and in which the revolving weight descended; it was also used, in the daytime, for the raising and lowering of stores, and likewise contained the waste-water pipe. The lower part of the tower was filled with concrete, leaving a well, faced with brickwork, about eight feet in diameter, and twenty feet in depth, in the centre. Above this were the seven floors, the two lower ones being lined with brickwork, and used as store-rooms, and the upper ones, lined with sheet-iron, were used as living-rooms for the lightkeeper. The details were then given of the mode of constructing the floors, the windows, the staircases, and of attaching the lantern and light-room to the main structure. It was stated that the light was visible from all points of the compass, excepting when obscured by the high land between Gibb's Hill and Castle Harbour, from the deck of a vessel at a distance of about twenty-seven miles, and possibly even at a still greater distance. The structure occupied less than one year in its actual erection, the different parts having been landed about the end of November, 1844, the first plate being erected on Gibb's Hill on the 19th of December, 1844, and the last plate of the tower on the 9th of October, 1845. The whole cost of the structure, including the lantern and light apparatus, was stated to have been about £7,690, and the annual expense of maintaining it about £450.

The next paper read was "A Description of Sir George Cayley's Hot Air Engine," by Mr. W. W. Poingdestre. After entering briefly into the theoretical considerations of the expansion of heated aeriform bodies, and detailing the attempts made by Lieut. Ericson, for employing hot air, instead of steam, as a prime mover, the author proceeded to state, that in 1837, Sir George Cayley, Bart., Assoc. Inst. C.E., applied the products of combustion from close furnaces, so that they should act at once upon a piston, in a cylinder, similar in every respect to that of a single-acting steam-engine. The engine consisted of a generator of heat, a working cylinder, and an air-pump or blower, the air-pump being half the size of the cylinder, and blowing air into, and through, a fire perfectly enclosed within the generator; the doors of the furnace were made perfectly air-tight as soon as the fire was well got up, the first impulse being given to the engine, by throwing a few jets of water upon the fire, which caused the air-pump to work immediately, and continued so for hours—the fire being replenished by stopping off the blast from the furnace, and opening the upper bonnet. After the air had passed through the fire, the gaseous products of combustion, generally at a temperature of 600° of Fahrenheit, passed laterally through a chamber, used for separating them from any ashes, or cinders, into the working cylinder before alluded to.

The difficulties attending this description of engine, were the liability of the working parts to be deranged, by the great sensible heat destroying the valves, pistons, and cylinders, and carbonizing the lubricating oil. It was stated, that Mr. A. Gordon, M. Inst. C.E., had made a successful experiment on the application of the heated products of combustion for propelling a boat, without the intervention of any machinery between the furnace and the water to be acted upon.

SOCIETY OF ARTS.

PRESIDENT—H.R.H. PRINCE ALBERT, D.C.L., F.R.S., &c.

JANUARY 16, 1850.

WILLIAM TOOKE, ESQ., F.R.S., VICE-PRESIDENT, IN THE CHAIR.

"On California, its Products, Climate, and Prospects," by Mr. Andrew Walls, being the result of a recent visit to that place by Alexander Cross, Esq.—Mr.

Walls, in the absence of Mr. Cross, read an interesting paper from the latter gentleman, who has recently returned from California, upon the present state of that country.

The state of California, containing about 350,000 square miles of territory, had, in 1839, a population, exclusive of Indians, of about 37,000, but at present the population is estimated at 90,000. Of the towns, he described San Francisco, the capital, as having a mild and healthy climate, but Monterey as the most pleasant for residence. The general quality of the gold found is 20 carats fine. The quantity of gold found in 1849 exceeded, in the aggregate, that found in 1848; but the average per person employed in the pursuit was less in the latter than in the former year. The present average at the diggings is 3 oz. of gold per day for each person. The influx of goods to the market at San Francisco has been such, that, owing to forced sales, goods now sent out are scarcely to be expected to pay charges, port dues, &c., to say nothing of prime cost. The wet season is from November to April, but during the summer months rain scarcely falls so often as once in four years. Gold has been found as far north as 500 miles from San Francisco, but the abundance is not equal in every place, and the chance of realizing a fortune depends upon striking a good "lead."

Mr. Walls likewise read a letter from a young American, giving a graphic and faithful description of life at the diggings. This person's best day's work was 400 dollars' worth, but the average was about 100 or 150, he having found a rich "lead." Living cost him 1 dollar 50 cents per day. In that district a pan of earth was never washed without finding some gold-dust in it, whether taken from mountain or valley; but it was no country to live in. Every one's aim was to make money and to be off; and he predicted that, in time, the population would be poorer than the people of the western states, the resources of the country being too slender to support any large population. Washing of clothes was remarkably dear, as much as 50 cents for a single garment; and the glut of the market having rendered clothes cheap, some threw away their dirty clothes instead of having them washed. The gold district also contains silver, but that has been, as yet, little thought of. Mr. Walls concluded by exhibiting a recent number of the Californian newspaper, and a number of specimens of the gold ore, both in dust and lumps. Among the latter was one of the largest yet brought to England, weighing about 7 lbs., and remarkably pure. It bore evident marks of attrition by the action of water, and a few crystals of quartz might be detected in it. The Bank of England gave 17s. 9d. per ounce for the gold he had sold to them.

Mr. Tennant cautioned those going to California to be careful as to what they might throw away as worthless, for in his microscopic observations upon specimens of gold ore from California, he had discovered fragments of the diamond and other precious stones, besides platinum. He also alluded to the large quantity lately received in this country. One mercantile firm, to his knowledge, had received consignments to the amount of ten tons in the last year. Gold ore is found in England, Ireland, and Wales, but seldom pays the expenses of working it.

Mr. Hawkins was extensively acquainted with the mines of central America, where he had lately been surveying, with the view of planning a communication between the two oceans. He stated gold was to be found in the whole ridge of mountains, from California southward to the Amazons. The matrix of the lumps was generally quartz, and he conjectured the dust was derived from the decomposition of the ferruginous granite which contained it. He also mentioned a curious circumstance that had come under his observation, namely, that in ancient mines, formerly worked by the Indians and Spaniards, and which had become inundated, the boring holes were occasionally filled up with crystals of quartz, containing gold.

JANUARY 23.

JAMES WALKER, ESQ., F.R.S., C.E., VICE-PRESIDENT, IN THE CHAIR.

"On Artificial Breakwaters, and the principles which govern their construction," by Mr. A. G. Findlay.—Mr. Findlay's paper commenced by stating, that it was not wished to pronounce upon the feasibility or impracticability of any of the numerous plans which have, from time to time, been proposed for the construction of breakwaters, but to submit some facts, drawn from natural effects, showing the forces to which such structures must be subjected.

The paper, therefore, was naturally divided into two parts. The first, which related to the action of the waves, and its collateral subjects; and the second, which was postponed for a future evening, will relate to the various forms which have been given to sea-barriers, and the history of the progress of those now in existence.

The principal difficulty in establishing a fixed breakwater was shown to be the enormous force of the waves. The form and nature of sea-waves generally were alluded to, and Mr. Scott Russell's system described. Of the dynamic force exerted by sea-waves, it was stated that their greatest force was at the crest of the wave, before it breaks; and its power in raising itself was measured by a number of facts. At Warberg, in Norway, it rose 400 feet, in January 21, 1820; on the coast of Cornwall it rose 300 feet in 1843. Other examples, as the singular "Souffleur" at the Mauritius, &c., were cited, showing that the waves have raised a column of water equivalent to a pressure of three to five tons per square foot; a result in accordance with Mr. T. Stevenson's observations with the marine dynamometer, which was described.

It was shown by a table, that the velocity of waves was dependent on their length; that waves of 300 to 400 feet in length, from crest to crest, travelled with a velocity of 20 to 27½ miles an hour, and this whether they were 5 or 54 feet in total height; this velocity alone, should they become primary waves of translation, would give them a great percussive force. That waves travel very great distances was instanced by several facts. That they are raised by distant hurricanes and gales was noticed, by their being felt simultaneously at St. Helena and Ascension, though 600 miles apart; and opinions quoted, that these rollers, or ground-swells, at times originated near Cape Horn, 3000 miles distant, rendering it more than probable that tropical hurricanes will send storm-waves to our own shores.

That it was not only at their surface that waves exerted great power, but that they reach in their action to the depth of eight fathoms and upwards, was shown by the operations for the recovery of the treasure from H.M.S. Thetis, which was wrecked and sunk at Cape Frio, Brazil, in 1831. The diving-bell was swung four or five feet laterally in calm weather in these operations, much increasing their danger. Besides this, the guns and treasure were found covered by masses of rock of from thirty to fifty tons weight, moved by the action of the water, and weighed or turned over in the second operations by Captain de Ross.

From these facts it was considered, that floating breakwaters generally were not adapted to combat with the waves. Admiral Tayler's plan, of timber framework sections; Captain Grove's iron cylinders, with an attached grating; Captain Pringle's frame, moored by its lower edge; Captain A. Sleigh's floating sea-barrier; Mr. Smith's plan, as submitted to the Society, were mentioned: and it was considered that the calculations of their resistance were understated—that Admiral Tayler's section, instead of twenty-five tons' strain, might, if the waves exerted only one-third of their force as known, have to withstand upwards of 1000 tons. This probably caused the failure of Admiral Tayler's experiment at Brighton, and Captain Grove's at Dover. Major Parlby's principle of the trumpet-mouth seaweed was compared with the *fucus giganteus* of Dr. Solander, abundant on the Patagonian and Fuegian coasts, and 360 feet in length, which is carried under water in currents, and torn up, and chokes all the bays during storms.

The motion of shingle, an important consideration in establishing breakwaters, was shown to be governed by the direction in which the surf strikes the shore, and this is dependent on the direction of the wind. This, from fifteen years' observation by M. Nell de Bréauté, at Dieppe, was shown to be in the ratio of 226 days from western quarters to 132 days from eastern quarters, giving that preponderance to its eastward progress. The mode in which it was arranged on the sloping beach, in the form of a paraboloidal curve, was explained.

Sand, a more powerful agent than shingle in changing the character of a coast, was stated to be deposited by currents, thus rendering the eastern parts of the English Channel much more embarrassed by them than the western portion. The Goodwin Sands were exhibited as examples of the extent of accumulation, and the changeable character of sand deposits. The diagrams exhibited showed the progress of these alterations, and were drawn from, perhaps, the only authentic history we possess of the changeable character of a quicksand. The different periods, from Græme Spence's survey in 1795, down to Captain Bullock's in 1850, showed that they had shifted miles in their position and area, evidently refuting the practicability of any principle which would apply to fixing them, and rendering them available more perfectly for breakwater purposes, as was proposed by Captain Vetch, R.E., to the Royal Commission, 1845.

JANUARY 30.

GEORGE MOFFATT, ESQ., M.P., VICE-PRESIDENT, IN THE CHAIR.

"On the Cause and Prevention of Oscillation in Locomotive Engines," by Mr. Heaton.—This lecture-worn subject has been fully noticed in our present volume, see pages 145 and 207 for example.

"On an Apparatus for aiding the Drivers of Locomotive Engines in cases of danger, and for preventing Collisions on Railways," by Mr. C. F. Whitworth.—The author proposes that each locomotive shall carry two pendent rods, about six inches long, and moving freely on axis, and acting on triggers. These triggers release two rods, each connected with levers which open their respective valves. One sounds an alarm-whistle; the other admits steam to a piston, in a small cylinder, whose action causes the lever of a throttle-valve to shut off the steam in the dome of the engine.

The piston-rod of this small cylinder, at the same time that it shuts the throttle-valve, applies a lever-break to the wheels of the locomotive, and also registers that to have been effected mechanically which the vigilance of the driver, under ordinary circumstances, would have superseded by his obeying the signal some 200 yards before.

The trigger-rods are acted upon by inclined planes of wood, placed parallel with the rails, and a few inches from them laterally. These rods are about four feet long, having hinge-joints at one end, and are capable of an elevation of four or five inches at the other.

This elevation from an horizontal position is, in general, produced by a partial rotation of a transverse spindle placed under the rails, and on which are fixed two cams, that, acting by pressure under the inclines, cause them to assume the elevation requisite. The rotation of the spindle is produced by a motion of the lever and wire-rope, which sets the distant signal; and the cams and lever on the spindle, together with weights for reaction, are so arranged as to cause an elevation or depression of the inclines in perfect accordance with the indication of the signal.

It should be remarked, that when the driver shuts off the steam himself, in accordance with the signal, this action lifts out of gear the trigger-rod, which would otherwise come in contact with the inclines; and that he cannot apply his steam without having replaced the rod, which is liable to expose any neglect of signals.

FEBRUARY 6.

JAMES WALKER, ESQ., VICE-PRESIDENT, IN THE CHAIR.

Mr. Findlay commenced the second part of his paper, "On Artificial Breakwaters, and the Principles which govern their Construction," by recapitulating some of the forces and circumstances to which breakwaters are subjected, as cited in the former abstract. The application of these was the subject of the present portion.

The preparations for the great Cherbourg *digue* were noticed; the proposals of 1712 and 1777 for a line of sunken ships filled with masonry, as at the siege of La Rochelle in 1573, and the first operations by M. de Cessart in 1782-4 were described. This latter plan was to sink truncated conical caisons, strongly framed of timber, 150 feet diameter, and 64 feet high, floated by means of a double tier of immense casks around their bases. The first and second were successfully launched; but before the latter could be filled with stones, as intended, a storm carried it away to low-water mark. This led to a great change in the plan; instead of 90 of these cones tangent to each other, they were to be placed at considerable distances apart, the intervals to be filled with *pierre perdû;* 18 of them were laid, but they were all destroyed but one before 1789, some of them in two days after their being placed. The method *à pierre perdû* was then resorted to, and continued with until it was modified by an upright parapet from low-water level by M. Dupare, 1832; the work is still in progress.

The series of four different slopes, in which the waves have distributed the stones of the *digue* was described; and the absence of the lowest slope in the Plymouth section was accounted for by the increased force of the waves upon the latter.

The commencement in 1811 by Mr. Rennie, and subsequent proceedings under its present superintendent, Mr. Stuart, of the Plymouth Breakwater, were then alluded to, and the increased length of foreshore which had been found necessary, from the original design, and the greater effect of the sea at its *west* end described. In 1838, from the great effects of a storm, a species of buttress was designed by Mr. James Walker, C.E., for the protection of the base of the lighthouse. This involved a new principle in hydraulic architecture, afterwards alluded to.

This structure resembles in some degree the system of dovetailing and grooves adopted by Smeaton in the Eddystone; but differs in its application. The Delaware breakwater in the United States was then briefly alluded to.

The principle of the presenting a concave face to the waves was then adverted to. In 1734, such a section was proposed, but not acted on, by M. Touros, for S. Jean de Luz. In 1787-95, Don Tornas Munos constructed the sea-walls of Cadiz thus: a straight foreshore of timber planking and a curved masonry termination. This was destroyed by the blocks of stone, placed at its foot for protection, rolling up the incline against the masonry. M. Emy, who endeavoured to establish the existence of what he denominates the *flôt-du-fond*, proposed a cylindrical or other curvilinear face for this purpose in 1818, and in 1820 repaired the works of the fortification of St. Martin, Ile de Rè, in the Bay of Biscay, on his plan, which was so far successful, though not very greatly exposed. Various forms of the concave *revêtement* were noticed, and the natural form assumed by the shingle beach was cited as an instance of the effect of beach surf. This form has been adopted in the Dymchurch wall constructed by Mr. Walker. The mode of action of the waves against a cliff was also explained, as producing a similar section.

Mr. Scott Russell's deductions from the wave system, leading also to similar conclusions, were then alluded to, and the sectional form he has proposed described. He preferred a paraboloidal curve for the foreshore; and an overhanging coping, so as to turn the wave on itself, was described. Mr. Russell, for deep-water structures, preferred the method *à pierre perdû*, forming a straight foreshore. One objection to this system of concave face was, the varying level to which such structures are exposed from tidal influences, and the differences of curve presented at different periods of tide.

From these systems, the vertical, or nearly vertical wall, was then described; and the great national work at Dover, the Refuge Harbour, was stated to be on the principle established by the experience of the buttress at the west end of Plymouth Breakwater. This mode of construction, found effective at that place, counteracts some of the difficulty met with in securing the masonry facing of it. In a previous part of the paper, it was stated that the stones were blown out of the facing, or towards the sea-wave. This action is attributed to the percussion force entering the joints, and thus the water or air contained within the body of the masonry being most forcibly driven upwards and outwards, carried single stones out of their beds. The new mode consists of stepping one course of stones into the upper surface of that beneath it, so as to form a ledge to prevent its outward tendency, and also to divert the direct action of the wave on the joint. In addition to this, each stone is so dovetailed on its horizontal plane, that each course forms virtually one stone; and alternate stones in each course are locked into the course beneath it; so that, throughout the fabric, some portion of each course belongs to the one on either side of it, making the whole into one mass. These stones are found at the quarries, and fixed in their places by the diving-bell. The situation of Dover Harbour, as being free from the chances of silting up, was considered in reference to the tides, and the improbability that any great amount of shingle would for the future embarrass the work.

"On Improvements in the Electric Light," by Messrs. Staite and Petrie.

Of all artificial lights, that produced by electricity is the most beautiful, pure, and perfect, and only inferior to that of the sun itself. The difficulties involved in its production are manifold; they have, however, been effectually overcome by the inventors' electro-magnetic regulator (placed on the table, and explained in action), which is self-regulating, and not easily deranged.

The carbon used by the inventors is almost chemically pure, of an exceedingly equal structure, and homogeneity, and, by a simple process, has been obtained at a very insignificant expense.

The conducting power of carbon is only $\frac{1}{2000}$th part that of copper; but, by peculiar arrangements, Messrs. Staite and Petrie have succeeded in supplying their lamps with electrodes for any definite number of hours.

By experiments, the inventors have determined formulæ, which yield, not merely comparative, but direct quantitative results as to the relation of the *quantity* of current-electricity to its *intensity;* and also, in any varying case, give the proper power of the electro-motive elements, their number in series, the diameter of the electrode, the length and section of the wire used for the regulator, its proportions when formed, &c., including the section for the conducting wires according to the distance of the light from the battery. The power of the light produced, the limit within which the power of the battery may be suffered to vary, and many minor points—all these being determined by correct laws, and applicable to all possible modifying circumstances. Messrs. Staite and Petrie assert that electricity has been reduced to a system so accurate in detail as to be relied on in practice.

A battery has been constructed by them in which fluid communications between the cells is effected in such a manner as to allow of the battery being charged and discharged in two or three minutes, whilst the strength of the solution used is kept perfectly uniform for very long periods, without the possibility of any local action on the zincs, and requires no sort of amalgamation. Further and fuller particulars concerning this will, on a future occasion, be laid before the Society.

By repeated experiments, Messrs. Staite and Petrie have satisfactorily proved that liquid communication between the cells of a battery, if properly arranged, will not affect either the quantity or intensity of the current, as supposed by many, while, at the same time, it gives the facility of maintaining the power for any given period.

The peculiar economy, which, by great concentration of action and high temperature with very little volume of heat, is obtained by the electric light, may be explained thus: the amount of radiant light increases in a vastly greater ratio than the increase of temperature. A series of curves, illustrated by a diagram, were produced, to show the relative increments of temperature, both in radiant heat and light, from a solid body. As far as experiments have gone, radiant light increases as the sixth power of the excess of temperature above 960° Fahrenheit. If, then, it is very expensive to maintain a given light by keeping a substance at a small increase of temperature beyond incipient luminosity, it will be far less expensive to obtain the same amount of light from a diminished illuminated surface, with a proportionately increased intensity of illumination, because the surface may be diminished in a far greater proportion than the current of electricity required; for the reduced surface must be increased to give the proportionate increase of light. Hence the proportion of luminosity for the given current producing it becomes exceedingly high where the heated surface is so concentrated, as in the case of the tip of the electrode, or rather the spot occupied by the disruptive discharge. The problem of rendering light from electricity continuous and economical has been solved. It has been already introduced by the Barge Steam Towing Company, and is in constant use in the Enterprise tug-boat, and is managed by the engineer on board without difficulty or failure. By the use of this light in houses, &c., all currents of vitiated air and gas are avoided, and a cool, pure, and perfectly shady light is secured.

ROYAL SCOTTISH SOCIETY OF ARTS.

November 11, 1849.

"On the Strength of Materials as applicable to the Construction of Cast or Wrought-Iron Bridges, and on the Conway and Britannia Tubular Bridges." By George Buchanan, Esq.

In this exposition, Mr. Buchanan, after apologising for the length to which he had been imperceptibly drawn in these communications, commenced by recapitulating the general principles which had formerly been laid down regarding the tensile and compressive strains of materials, and, in addition to the results of former experiments, made at the request of the Society, on the stones from different quarries in the neighbourhood, gave now the results of others which had since been carefully made on the harder materials of Caithness and Arbroath pavement, along with white marble and whinstone, as follows, viz. :—

	Tensile. lbs.	Compressive. lbs.
Whinstone,	1469	8270
Arbroath pavement,	1261	7884
Caithness do.	1054	6493
Marble,	722	6431

In all these experiments the peculiar nature of the two strains is distinctly exhibited: the specimens exposed to the tensile strain showing a clean fracture and no fragments; those exposed to the compressive being generally crushed to powder, and the fragments flying in all directions by lateral divergence; and, generally, when any considerable fragment remains, showing the appearance of a pyramid from which the sides of the square had been broken—a form which has also been observed in the compression of cast-iron.

In regard to the transverse strength, he repeated the principles and general rule for calculation formerly explained by adopting what he termed a unity of strength, which differs in each material, but being once determined by actual experiment, affords a *datum* for calculating the strength of that material in every case, whatever be the dimensions of the masses acted on. This unit expresses the strength of a cubic inch of the material, *i. e.*, a bar one inch square, supported on bearings one inch apart, and loaded in the middle till it breaks. The strength of such a unit for cast-iron had been given on a former evening at 11 tons. In regard to timber, he had himself made various experiments on Memel fir, and had found the unit 4000 lbs. Oak and beech, by other experimenters, was found 6000 lbs.; ash, 8000 lbs.

In regard to the transverse strength of stones, few experiments, he said, had been made on our building materials, although it was a strain they were much subject to in stairs, balconies, covers of conduits, &c. He proposed, therefore, to try several specimens which were now before the meeting, viz., Hailes pavement, Craigleith, and Arbroath. Each of these specimens was three inches thick, nine inches broad, laid flatways and supported at each end between two upright pillars, the distance between the bearings being exactly three feet. These specimens were loaded by weights successively laid on a scale hung from the centre of the pavement, until it broke. The Hailes was first tried, and, after carrying successively 4 cwt. and 5 cwt., for a little time, at last it gave way with 7 cwt. 10 lbs. A specimen of the same rock and dimensions previously tried gave nearly the same result, being $7\frac{1}{4}$ cwt. The Craigleith carried considerably more. After bearing 7 cwt. and 8 cwt. for some time, it gave way at last with $10\frac{1}{4}$ cwt. The Arbroath pavement was found still greatly ahead even of the Craigleith. After carrying 12 cwt. and 14 cwt. for some time, it went on bearing $16\frac{1}{2}$ cwt. This it bore for a short interval; and while an additional weight was in the act of being put on, it gave way. These experiments are important, and appeared to excite much interest. From these the unit of strength is easily calculated.

The transverse strength and the forms of cast-iron girders for spanning wide openings were formerly explained, and the application of malleable iron in the form of hollow tubes or girders; and, connected with this subject, he explained a plan which had lately been proposed by Mr. Beardmore, C.E., London, who had favoured him with the results of some interesting experiments made by him. The plan consisted in constructing fire-proof or other floors by girders, consisting merely of thin plates of sheet-iron running parallel to each other at intervals, like ordinary joists, resting on the walls at each end; these plates strengthened and united to angle irons on the top, and to a thin plate below, running the whole way between the girders. The interval between them is filled up with a mass of concrete, the use of which is chiefly to keep the thin plate girders in their place, so that, being incapable of bending, the full effect of the section of the iron is obtained, whereby the strength of such flooring, considering the thinness of the metal employed, is truly remarkable. In one experiment, where the girder consisted of sheet-iron, No. 14 guage, or $\frac{1}{12}$ of an inch thick, and 13 inches deep, and placed 13 inches apart, and the length or span between the walls or bearings 23 feet; also the total sectional area $6\frac{3}{4}$ inches, while that of the concrete was 331 inches. This was loaded with 8000 lbs., which is nearly double the weight of any number of persons that could have room to stand on the beam, and only deflected $\frac{1}{2}$ inch. With 12,000 lbs. it deflected about $\frac{3}{4}$ inch, which was considered the probable limit of safe deflection. With 13,670 lbs. it deflected 1 inch. It was not loaded farther, but the calculated breaking weight was 25,000 lbs. Mr. Buchanan then showed a model of a floor on this principle, consisting of the thinnest tin-plate iron girders, 3 feet long, $1\frac{1}{2}$ inch deep, and 2 inches apart, and the spaces filled in with plaster of Paris. Even this slender material carried with safety a person standing in the middle, and gave way with 3 cwt., chiefly owing to the joints in the bottom plate not being soldered, but merely laid over.

In regard to the application of hollow girders, or tubes, and the wonderful discoveries on this subject which the progress of engineering works had recently brought to light in the construction of the Conway and Britannia Tubular Bridges, he had formerly given a particular account of these, and had only now further to add, that he had the pleasure recently of visiting these structures, and was in every respect highly gratified with the result, and with the progress and state of the works, which were all pointed out to him and explained in the most liberal manner by Mr. Edwin Clark, the very able and accomplished engineer on whom the active charge of the principal department in this undertaking had been devolved by Mr. Stephenson.

The Conway Bridge, as we know, has been long since finished, and the trains on the Chester and Holyhead Railway are seen daily passing and repassing. It ceases already to be any longer a wonder in the neighbourhood, yet the stranger pauses to gaze with admiration on this extraordinary triumph of science and engineering skill, as the train enters the tube, and again emerges under the walls of the magnificent remains of Conway Castle. In passing through the tube, the sound of the train is peculiar, but not greatly louder than in ordinary tunnels. No sensible tremor or vibration is experienced; and the heaviest trains, when observed externally, do not produce any visible deflection. The line of the under surface of the tube is quite horizontal. The upper surface rises with a gentle curve towards the centre. The under surface had also, when constructed, a slight rise or camber in the centre, of about seven or eight inches; but when the supports were removed from beneath, leaving it standing on the two extremities, it sunk in the middle by its own weight into a straight line, and this exactly as was intended by the engineers, showing the accuracy of the principles and data on which such nice calculations could previously be made of the probable deflection, and this chiefly from the experiments on the model tube by Mr. Fairbairn, described on a former evening.

The Britannia Bridge, to which he next proceeded, is a still greater work even than the Conway, and connected with many circumstances calculated to impart interest to this structure, and everything connected with it. The curiosity and wonder excited by the famous bridge of suspension over the Menai Straits were great, and he well recollected visiting this work during its progress, and the vast operations, as they were then considered, of fabricating, connecting, and finally lifting the enormous chains of which it is composed, each of which, after all, hardly exceeded 100 tons, between rock and rock, and the central portion, which alone had to be lifted by one purchase, not above 30 or 40 tons. The principle of suspension, also, was not quite new, but had previously been exemplified in structures of considerable magnitude; still this was considered, and justly, an astonishing effort of skill, and remains a monument of the genius of Telford. What must we think, then, of the structure now in progress, and already seen partly spanning the same straits, which is not only new in principle, and untried before the great experiment of the Conway, but where the entire bridge itself, nearly 2000 tons in weight, requires not only to be floated on the water from the place of its construction, but then raised more than 100 feet in perpendicular altitude in one mass, and by one mighty purchase, to its seat on the top of the towers prepared for it. What extraordinary strength of materials—of chains, bolts, bars, and connections—does not this imply! What amazing resources of mechanical power and combination in the lifting machinery! What consummate arrangements, in launching the gigantic mass into the troubled waters of these straits, and steering it with safety to its destination! All these circumstances tend to raise a singular degree of interest in this structure, and the operations connected with it, and the result fully realized his anticipations, of which, however, he could only give but a faint idea by description.

The first view which the traveller obtains is in crossing the straits by the present suspension bridge. Looking about a mile to the westward, the towers of the Britannia Bridge are seen rising with imposing effect; the centre one, as it were, from out of the water, the two exterior ones from the edge of the waters, and the terminal pillars or abutments on the top of the high ground on each side. But the object to which the attention above all becomes riveted, is the appearance of an extended wall or roadway spanning the 460 feet opening between the Britannia tower and the Anglesea shore. This is the first of the four tubes which has been raised to its elevation of 103 feet above the waters. This is, in fact, *the bridge*, standing without any appearance of support, and totally unlike any of the great works of this kind which have hitherto formed the pride of the architect and engineer. No more the noble arch rising, as we often see, so magnificently from the level of the opposite shores, nor the light and elegant curve of suspension, hanging with such regular and airy proportions between the lofty towers on each side; but a figure, perfectly horizontal and nearly rectilineal, spanning the opening and resting on the opposite towers—a figure certainly unequal to the others in beauty, but yet raising in the mind a sensation irresistibly striking, as exhibiting on such a magnificent scale the successful development of a new, grand, and simple idea in mechanical science.

Mr. Buchanan then proceeded to give an interesting description of the situation of the bridge, the romantic shores of the estuary, the extraordinary phenomena of its tides rushing in from the great sea at either extremity, and producing, by the concurrence of waters, and other circumstances, peculiar anomalies, and, above all, currents, running often at the rate of seven and eight miles an hour; and, lastly, the extraordinary and exciting operations connected with the launching of the first great tube, and floating it through those waters and currents; the difficulties, the dangers, and the singular incidents which occurred during the brief and trying moments of this extraordinary enterprise, but which, by the long-matured and perfect arrangements previously made, all ended in depositing it safely on its site between the piers.[*]

The next great operation to be described was that of the lifting of the tube, but the description of which, owing to the important business before the Society this evening, of distributing the annual prizes to the successful competitors for inventions and communications, was necessarily deferred to another evening. In conclusion, particular reference was made to the great work which is now preparing by Mr. Edwin Clark, with Mr. Stephenson's sanction and advice, being a history and description of the Conway and Britannia Tubular Bridges, with all the operations, and illustrated by very numerous drawings, on a large scale, of the details of the work, and also an account of the various experiments on the strength of iron, riveted joints, &c., some of the results of which, as communicated to him by Mr. Clark, he would state at the next meeting.

Report of the Prize Committee, Session 1848—49.

1. To Mr. James S. Torrop, Edinburgh; for his description and model of a "Time-Signal for Railways, Steamboats," &c. and for his "Notice of a peculiar property of Gutta Percha." The honorary silver medal.

2. To Mr. John Charles Pearce, Manchester; for his "Remarks on the benefit of using Steam expansively in Locomotives and other non-condensing Steam-Engines." The honorary silver medal.

Note.—The committee, though not approving of Mr. Pearce's proposed valves, highly approve of his remarks on the use of expansive steam.

3. To Mr. Hay Dall, Brassfounder, Glasgow; for his description and elegant working model of an "Improved Bramah Press." The silver medal, value twenty sovereigns, including value of model, £10.

Note.—In awarding this prize, your committee have allowed ten sovereigns for the model. They have also to report that the prize is given for Mr. Dall's valuable improvement of the "*stop*," whereby the pumping of the water is stopped on the pressure arriving at a certain maximum; thus forming a complete safeguard against overstraining and breaking the press. Although very ingenious, the committee cannot recommend Mr. Dall's *differential safety valve*, which depends too much on correct fitting to be safe in the practical working; and would recommend the usual safety-valve along with Mr. Dall's "*stop*" on the pump, especially in large establishments, where the presses are numerous, and are wrought by steam-power.

4. To Thomas Wright, M.D., Edinburgh; for his description of a "New Electro-Magnetic Coil Machine." A specimen machine to be furnished by Dr. Wright. The silver medal and plate, value ten sovereigns.

5. To Messrs. T. and W. Stirling, Stratford, Essex; for their description, drawing, and model of a "Rapid Filter." The silver medal, value ten sovereigns.

6. To John Anderson, Esq., Pratis, Fifeshire; for his description and working-

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[*] For an account of this and other topics connected with the Conway and Britannia bridges, he referred particularly to an able and highly interesting article in the *Quarterly Review*.

model of a "Revolving Valve for Locomotive and other Steam-Engines." The silver medal and plate, value ten sovereigns.

7. To Mr. James Scott, Carpenter, Leith; for his description, drawings, and model of an "Hydraulic Dock," intended for repairing vessels in places where, from there being little or no ebb and flow of tide, the ordinary dry dock or patent slip cannot be constructed. The silver medal, value ten sovereigns, including value of working model.

8. To Mr. John Stiven, St. Leonard's Depot, Edinburgh; for his description and model of an "Improved Method of Hanging Windows," whereby, at small expense, windows in common use can be so altered that the sashes can be taken out and cleaned, glazed, or painted in the interior of the house. The silver medal, value seven sovereigns, including value of model.

9. To Mr. Robert Skelden, Signal-man, Hawick Junction, North British Railway; for his description, drawing, and working model of a "Railway Signal, and method of working it at a considerable distance from the Station." The silver medal, value five sovereigns.

10. To Mr. William R. Douglas, Carpenter to the Right Hon. Lord Torphichen, Calder House, Mid-Calder; for his description and working model of a "Machine for cross-cutting Firewood, and other purposes." The silver medal, value five sovereigns.

11. To Mr. George D. Howell, Edinburgh; for his description and model of a "Machine for dressing Straw Bonnets, where hot or cold pressure is required," calculated to relieve females who dress these articles from severe pressure on the breast, and also from the noxious fumes which arise from their work, both of which are so injurious to their health. The silver medal, value five sovereigns.

12. To Mr. William Smith, Musselburgh; for his description and drawing of a "Timepiece moved by a spring of Vulcanized Caoutchouc."[*] The silver medal, value four sovereigns.

13. To Mr. James Robb, Haddington; for his description and model of an "Air or Stink Trap, for preventing noxious effluvia proceeding from drains and common sewers." Three sovereigns.

Reports on the following papers are postponed till next session, viz., on Mr. Cooper's new Furnace for melting glass, till it can be tried in comparison with the furnaces presently in use; on Mr. Carrick's Water-Meter, until working model be sent; on Mr. Thomas Stevenson's Harbour Screw-Cramps, till the effect of them can be tried.

The reports on Mr. T. Stevenson's improved fixed and revolving Lights; on Captain Hall's method of warming and ventilating; on Mr. A. Bryson's Meteorological Clock; on Mr. Mitchell's Norwegian Water-telescope; and on Professor Simpson's Air Tractor, have not yet been given in.

December 10, 1849.

Thomas Grainger, Esq., C.E., President, in the Chair.

The meeting was opened with an address from the President—"On the desirableness of obtaining communications relative to the Construction and Details of Engineering and other Public Works," accompanied by the necessary Models and Drawings.

"On a Chromatic Stereoscope." By Sir David Brewster.

The instrument consists of one lens $2\frac{1}{2}$ inches in diameter, or upwards, through the margin of which each eye looks at an object, having *two* colours of different refrangibility. The effect of this is to cause the two parts of the object thus differently coloured, to appear at different distances from the eye, just as in the *Lenticular Stereoscope*, the two parts of an object that are nearest to one another in the double picture rise in relief, and give the vision of distance as of a solid figure.

The instrument may consist of two semi-lenses, convex or concave, or of two prisms, with their refracting angles placed either towards or from one another; and the effect is greatly increased if the lenses or prisms have high dispensive powers, such as flint-glass or oil of cassia.

"Description of a New Invention in Lithography, made by Messrs. Schenck and Ghemar, Lithographers, Edinburgh." By Mr. F. Schenck.

Mr. Schenck stated, that the important merit which this invention possesses consists in its taking advantage of the chemical composition of the lithographic stone, and the chemical nature of its printing. Upon this basis the inventors have made trials, and have succeeded beyond their most sanguine expectations, *i. e.* to produce almost instantly the middle tints of any surface, and which will print—a result which is precisely that which, in every other mode of printing, requires a considerable time—and to finish with ease a drawing in a spirited and artistic manner, in a brief space of time, and with comparatively little previous practice.

Mr. Schenck stated, that the reproach which has often been justly made against lithography, relative to its grey tone and want of colour, need no longer be advanced, as those defects are from henceforth happily overcome; and it may now be safely averred, that the chief feature in that beautiful art will in future be the remarkable ease with which great power, depth, and brilliancy of tone, together with a variety of texture, can be attained—features so important in drawings, and which can now be produced in an incredibly short time (about one-tenth, often one-twentieth part of the time required to do finished lithographs in the ordinary chalk method).

He stated that painters will in future have it in their power, with comparatively little practice, to immortalise their names in their works, even as Rembrandt, not with the etching needle, but by the simple process of rubbing, the use of the scraper, stump, chalk, the pen and brush, nay, even by rubbing with their fingers on the stone, and will produce lithographs, combining a richness of colour, with variety of tint, of which no Rembrandt can boast, and an artistical merit of touch, the etching needle could in vain attempt.

He stated that a Michael Angelo, or a David Wilkie, could have it now in their power to produce an original drawing of large size on stone within a day or two, possessing a strength of which no mode of printing has hitherto shown proof, and producing an effect equal to a painting.

He stated that publications on an extensive and frequent scale will now become possible things, the rapidity of execution and consequent cheapness, together with the pleasing and novel effect, must give an impulse to the diffusion of works of art and genius, which a mere question of time and expense has hitherto rendered almost impossible.

The inventors, he said, do not desire that lithography should be either imitative of, or pretend it will ever supersede copper, steel, or wood engraving. They claim for it an entirely *independent* position among the fine arts, which they stated it will now easily obtain from the assistance of great painters, sculptors, and architects.

From the simplicity of its treatment, the beautiful results obtained, the immense improvements it will effect on lithography, and its useful influence on art in general, Mr. Schenck trusted he had in some measure been able to convince the Society of the value of the invention he had been endeavouring to explain.

"Description and Drawings of Fire-Cocks, or Hydrants, manufactured under Bateman and Moore's and Chrimes' Patents." By Messrs. Guest and Chrimes, Brass Works, Rotherham.

The concluding paper was on Chrimes' Fire-Cock, which was fully described by us at page 209, vol. i. These fire-cocks were stated to have been adopted, out of many competitors, by the Corporation of Manchester, for their magnificent new Water Works, and also by the town of Kilmarnock in Scotland.

MONTHLY NOTES.

Corn-Mill Machinery.—Messrs. Joyce & Co., of the Greenwich Iron Works, have just completed, and are about to despatch to Smyrna—under the auspices of the Smyrna Steam-Mill Company—the machinery of a very extensive corn-mill, which is to be erected in that country. The mill-work is very simple and effective, and will, when completed, employ 14 pairs of stones, and grind upwards of 1000 quarters of corn per week. The whole is driven by a pair of Joyce's pendulous[*] engines of 50 horse power nominally, but really capable of working up to 100 horse, with a slight increase of steam pressure, for which there is ample boiler space provided. On Saturday, the 19th instant, Messrs. Joyce's works were visited by a great number of engineers and scientific gentlemen, to inspect the machinery then on the eve of departure. All expressed themselves highly delighted with the machinery, but the principal attraction was evidently the engines. The principle of these engines has been frequently treated of in our pages. We shall therefore content ourselves with giving Mr. Elijah Galloway's opinion of them. He says—"The principle of these engines is admirable, and divests the system of expansive steam, as applied to combined cylinder engines, of the charge of complication, very fairly urged against them before the introduction of Mr. Joyce's improvements. From the simplicity attained by these improvements as here presented, they cannot fail to work most economically as regards consumption of fuel (which I am quite sure will be under the amount guaranteed, viz., $3\frac{1}{2}$ lbs. per horse power per hour), while the small number of working parts, and the direct action of the forces, must insure great durability, and a vast reduction in the wear and tear."

Sampson's Safety Apparatus for Steam-Boilers.—We have before us a drawing of a safety-valve, invented by Mr. T. Sampson of Hayle Foundry, Cornwall, by whom it was laid before the Royal Cornwall Polytechnic Society in September last. It is so contrived, that in case of the water getting below the proper level, a jet of steam will be blown off into the flue tube, thus alarming the engineman, whilst the action of the jet will tend to prevent the flue, if uncovered, from getting overheated. An open-topped cylinder, fitted with a metallic piston, is bolted down to the top of the boiler. Beneath the piston is a side branch, opening into the top of the chamber of a small lever-weighted valve, which valve is open to the boiler beneath. When the steam-pressure raises this valve, its escape-steam passes into the cylinder and raises its piston the rod of the latter being connected, by a looped link, with the weighted end of the lever of a large valve on a branch from the man-hole; thus, the steam-pressure is made to act through the piston upon the large valve, and permit of the due escape of over-pressure. When the pressure drops to the proper point, the small valve acting first, again closes, and a partial vacuum being formed beneath the piston in the cylinder, the atmosphere will force it down to its original position. In the front of the boiler is placed a float, with a rod and chain passing up to a lever working a double-beat valve on a branch on the man-hole opposite to the large valve. The steam thus blown off, when the water gets too low, is conducted into the central flue of the boiler, as before stated.

Building for the Exposition of 1851.—We have before us the first of a host of candidates, which are likely, we presume, to be bidders for the honours that will belong to the edifice adopted for the great Industrial Exhibition next year. A small plan and an isometric view of a system of galleries has reached us, on a sheet of paper which bears no author's name. The plan of the whole is a circle; and at the heart is a circular central hall, 130 feet in diameter—radiating from which are eight corridors, each 300 feet by 50 feet—of proportionate height—having at their several outer extremities, entrances, with attendants' rooms. These communicate right and left, according to the accompanying description, with eight corridors, each 200 feet by 30 feet—enclosing eight large covered courts, all receiving their light from above—thus providing a large mass of wall. The central hall is surmounted by a dome; and this part of the building is intended for models that require height—being 60 feet high to the springing of the dome. The clerestory windows around its sides are intended to receive specimens of stained glass. The other parts of the building are arbitrarily, but not necessarily, appropriated, according to the views of the designer; and the plan allows of extension to any scale. It would not, however, suit the space at present supposed to be the probable site of the intended Exhibition.—*Athenæum.*

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[*] For a drawing and full description of this clock, see page 200, *ante*.

[*] For an account of which, see part I., vol. i., *Practical Mechanic's Journal.*

ENGLISH PATENTS.

Sealed from 18*th January*, 1850, *to* 13*th February*, 1850.

Macgregor Laird, Birkenhead, gentleman,—"Improvements in the construction of metallic ships or vessels, and in materials for coating the bottoms of iron ships or vessels, and in steering ships or vessels."—January 19.

William Beadon, jun., Taunton, Somerset, gentleman,—"Improvements in conveying away or decomposing smoke and products of combustion from stoves or grates, and in ventilating rooms of residences."—19th.

George Simpson, Buchanan-street, Glasgow, civil and mining engineer,—"A certain improvement or improvements in the machinery, apparatus, or means of raising, lowering, supporting, moving, or transporting heavy bodies."—19th.

William Wood, Over Darwen, Lancashire, carpet manufacturer,—"Improvements in the manufacture of carpets and other fabrics."—23d.

Christopher Nickels, York-road, Lambeth, Surrey, gentleman,—"Improvements in the manufacture of woollen and other fabrics."—23d.

Walter Westrup, Wapping, Middlesex, miller and biscuit baker,—"Improvements in cleaning and grinding corn or grain, and in dressing meal or flour."—24th.

Auguste Reinhard, Leicester-street, Leicester-square, Middlesex, chemist,—"Improvements in preparing oils for lubricating purposes, and in apparatus for filtering oil and other liquids."—24th.

Joseph Long and James Long, Little Tower-street, London, mathematical instrument makers, and Richard Pattenden, Nelson-square, Surrey, engineer,—"An improvement in instruments and machinery for steering ships, which is also applicable to vices, and other instruments and machinery for obtaining power."—24th.

John Dalton, Hillingworth, calico-printer,—"Certain improvements in and applicable to machinery or apparatus for bleaching, dyeing, printing, and finishing textile and other fabrics, and in the engraving of copper rollers and other metallic bodies."—26th.

Edwin Heycock, Leeds, York, merchant,—"Certain improvements in the finishing and dressing of woollen cloths."—26th.

Thomas Richardson, town and county of Newcastle-upon-Tyne, chemist,—"Improvements in the manufacture of Epsom and other magnesian salts; also alum and sulphate of ammonia."—26th.

Winceslas le Baron de Traux de Wardin, Liege, Belgium,—"Certain improvements in looms for weaving linen, woollen, and cotton cloths, and in machines for preparing the yarns for such cloths before entering the loom, and in a machine for finishing grey and bleached linen cloths."—26th.

Thomas Schofield, Cornbrook, Hulme, near Manchester, Lancaster, fustian dyer and finisher, and Henry Horabin, Royton, near Oldham, in the same county, fustian cutter,—"Improvements in machinery for cutting fustians and certain other fabrics to produce a piled surface."—26th.

Thomas Berger, Hackney, gentleman,—"Improvements in the manufacture of starch."—26th.

Richard Roberts, Manchester, engineer,—"Improvements in the manufacture of certain textile fabrics, in machinery for weaving plain, figured, and terry or looped fabrics, and in machinery or apparatus for cutting velvets and other fabrics."—29th.

Donald Beatson, Green-street, Stepney, Middlesex, mariner,—"Certain improvements in instruments for taking, measuring, and computing angles."—29th.

Edward Riepe, Finsbury-square, Middlesex, merchant,—"Improvements in the manufacture of steel."—(Communication.)—29th.

Joel Spiller, Battersea, Surrey, engineer,—"Improvements in cleaning and grinding wheat."—29th.

John Mason, Rochdale, and Mark Smith, Heywood, both in Lancaster, machine makers,—"Certain improvements in machinery or apparatus for preparing, spinning, and weaving cotton and other textile materials, and also improvements in the method of preparing yarns or threads, and in the machinery or apparatus employed for such purposes."—29th.

Francis Edward Colegrave, Brighton, gentleman,—"Improvements in saddles, parts of which improvements are also applicable to the standing rigging and other furniture of ships or vessels, and to the connecting links or chains of railway carriages, and other purposes, where tension combined with a certain degree of elasticity is required."—29th.

James Templeton, Glasgow, Scotland, manufacturer,—"Certain improvements in manufacturing figured fabrics, principally designed for the production of carpeting."—29th.

William Edward Newton, Chancery-lane, civil engineer,—"Improvements in machinery or apparatus for making hat bodies and other similar articles."—(Communication.)—29th.

Thomas Bury, Salford, Lancaster, silk, worsted, and piece dyer and finisher, and Nathan Ramsden, of the same place, calenderman and finisher,—"Certain improvements in the construction of machines for glazing, embossing, and finishing woven fabrics and paper."—31st.

Albert Dummler, Mark-lane, London,—"Improvements in obtaining fibres from textile plants."—(Communication.)—31st.

Etienne Joseph Hanon Valck, Belgium, miller,—"Improvements in grinding."—31st.

Edward Highton, Clarence Villa, Regent's-park, Middlesex, engineer,—"Improvements in electric telegraphs, and in making telegraphic communications."—February 7th.

Charles Atherton, member of the Institution of Civil Engineers, London,—"An improved apparatus or machinery for regulating the admission of steam to the cylinders of steam-engines."—7th.

Thomas Auchterlonie, Glasgow, manufacturer and calico printer,—"Improvements in the production of ornamental fabrics."—7th.

Edward Ormerod, Manchester, mechanical engineer, and Joseph Shepherd, Chorlton-upon-Medlock, mechanical engineer,—"Improvements in or applicable to apparatus for changing the position of carriages on railways."—7th.

Louis Jean Jacques Viscount de Serionne, Paris,—"Certain improvements in the manufacture of buttons, and in the apparatus and machinery used therein."—9th.

Bryan Donkin the younger, Bermondsey, Surrey, civil engineer, and Barnard William Farey, Old Kent-road, same county, civil engineer,—"Improvements in steam-engines, and an improved fluid meter."—9th.

Read Holliday, Huddersfield,—"Improvements in lamps."—11th.

William Blinkhorn, Sutton, Lancashire, glass manufacturer,—"Certain improvements in machinery to be used in the manufacture of glass."—11th.

James Webster, Leicester, engineer,—"Improvements in the production of gas for the purposes of light."—12th.

John Macintosh, Berner's-street, Oxford-street, Middlesex, civil engineer,—"Improvements in obtaining power, in the floating of bodies, and in conveying fluids."—12th.

DESIGNS FOR ARTICLES OF UTILITY.

Registered from 19*th January*, 1850, *to* 13*th February*, 1850.

Jan. 19th,	No. 2153.	Joseph Gray and Henry Lawson, Sheffield,—"Continuous stream enema-fountain syringe."
—	2154.	Robert John Blyth, Eagle Foundry, Norwich,—"Corn-thrashing drum."
22d,	2155.	John Roberts, Eastcheap,—"Ventilating flower-pot."
—	2156.	Henry Charles James, Oxford-street,—"Collapsable trunk or portmanteau."
23d,	2157.	John Samuel Phene, Cambridge,—"Hook and eye."
—	2158	James E. MacCabe, Parliament-street,—"Covers and backs for binding, or the temporarily binding pamphlets," &c.
24th,	2159.	Joseph Welsh and John Margetson, Cheapside,—"Equestrian or driving poncho."
—	2160.	Henry Burrage, Bath Buildings,—"Triangular ventilating top."
26th,	2161.	White and Grant, Glasgow,—"Safety-cage and disengaging catch for mine shafts."
—	2162.	John Sherratt and Charles Pickering, Walworth,—"Bottle neck and stopper."
—	2163.	John Head Hopkins and Son, Birmingham,—"Apparatus for heating water for baths and other vessels."
28th,	2164.	Thomas Kennedy, Kilmarnock,—"Waterproof gun-nipple."
—	2165.	Benjamin Levy, High Holborn,—"Expanding vest."
29th,	2166.	James Finlayson, Johnstone,—"Thread finishing or polishing machine."
—	2167.	Charles Leesley, Sheffield,—"Back for razor blade."
31st,	2168.	Francois Van Den Brande, Bedford-street, Bedford Square,—"Extending loo table."
—	2169.	George Houghton, Birmingham,—"College cap."
Feb. 2d,	2170.	John Sanders, Birmingham,—"Door knob."
4th,	2171.	David Mather, Dundee,—"Automaton blow-off apparatus and salinometer for marine steam-boiler."
6th,	2172.	Langman, Ward, & Co., Wolverhampton,—"Burner for burning luxurine or other spirit."
—	2173.	Thomas Wharton, Birmingham,—"Inkstand."
—	2174.	Henry Hopwood, Scarborough,—"Portable mangle."
—	2175.	J. and E. Ratcliffe, Birmingham,—"Universal reservoir inkstand."
7th,	2176.	Josiah Sims, Tavistock,—"Oven for a domestic cooking stove."
8th,	2177.	Louis Rodolph Bodmer, Manchester,—"Door spring."
—	2178.	Martin, Basket, and Martin, Cheltenham,—"Porte-fleur brooch."
9th,	2179.	Cope and Collinson, Birmingham, and Berwick-street, London,—"Bracket for Venetian blinds."
—	2180.	John Lingard, Sheffield,—"Pocket knife."
—	2181.	Scott and Thomson, Upper Ground-street, Blackfriars,—"Ladle for pouring melted metallic and other substances."
11th,	2182.	W. Kidston and Co., Bishopsgate-street, Without,—"An instrument for drawing blood."
12th,	2183.	Wm. Brooksby Crab, Motcomb-street, Belgrave-square,—"Accelero clasp."
—	2184.	John St. Quentin, Norwich,—"Water closet."
—	2185.	J. J. Wilson, Arundel-place, Haymarket,—"Brush."
13th,	2186.	Enoch Oldfield Tindall, and Lorenzo Tindall, Scarborough,—"Imperial mangle and wringing machine, with horizontal spring pressure."

TO READERS AND CORRESPONDENTS.

Volumes I. and II. of the *Practical Mechanic's Journal* are now completed, and may be had from any bookseller, in cloth and lettered, price 14s. each. It contains 292 pages demy quarto, with 18 large copperplate engravings, and 277 engravings on wood. Cloth covers, lettered in gold, may be obtained separately, at 1s. 6d. each. Subscribers may have their parts neatly done up in these covers for 2s.

W. J. S.—We omitted last month to give him a reply to one portion of his query, and will now add the required information. Formyle, C_2. H. is a hypothetical radical, supposed to be the basis of formic acid, C_2. H. O_3. Formic acid is obtainable from a mixture of 2 parts of crystallized tartaric acid, 5 of peroxide of manganese, 5 of sulphuric acid, and 5 of water. After mixture, these ingredients effervesce violently, and give off carbonic acid abundantly. If afterwards distilled, the formic acid passes over, and may be concentrated *in vacuo*.

W. C. P., Bishopwearmouth.—We have no special treatise of the kind, but he will find some good plates of steam flour-mills, with practical descriptions, in Messrs. Blackie's *Engineer and Machinist's Assistant*.

W. C. M.—Really he poses us. If his question is a quibble, we should say "yes," if he pushes the piston along by hand. If he asks in the good faith of greenness, we at once tell him "no;" else, what is to keep up the movement through a foot stroke? His second inquiry resolves itself into the first. Read the simplest mechanical book as to the law of "virtual velocities."

A Tyro, Liverpool.—If we were writing a regular elementary treatise, we should certainly attend to the accurate groundwork detail of our subject; but he surely cannot expect that the "uninitiated" should expect us to wade through the veriest rudiments of which our *Journal* professes to treat. Smee's own works are to be found in every Mechanics' Institution, and we cannot refer him to a better authority for the information he wants.

R. S. T. is rather hard upon us. The subject is only *now* assuming a commercially practical form, fit for treatment in the pages of a *practical* Journal. He is probably not aware of the difficulty of obtaining accurate information on points like this, where the truth of the matter is often made subservient to individual interests. When we are in a position to take up the subject thoroughly, we shall do so. The paragraph he formerly mentioned *was* a mere newspaper one, and, as far as our memory serves us, related in no way to the scheme now in operation. He is wrong in saying that the first notice appeared elsewhere, as, if he were an attentive reader of the *Practical Mechanic's Journal*, he would have seen our general description last month, and we now give the illustrative sketches, which could not have been given by us earlier.

J. P., Cambridge.—We shall furnish some notes on this invention next month.

A Chesterfield correspondent wishes to have "treatises on the galvanic battery—its best form,—and on the electrotype as used for plating metals."

Books Received.—"Dempsey on Tubular and other Iron Girder Bridges."—"Bingham's Photogenic Manipulation."—"Hughes' Explanatory Arithmetic."—"Hughes' Outlines of Physical Geography."—"Report of the Commission of Patents to the Senate of the United States on Steam-boiler Explosions."—Also an "Essay on the Present and Future Prospects of Farming in Great Britain," by W. Thorold, C.E.—And "Truths and Tubes on Self-supporting Principles."

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